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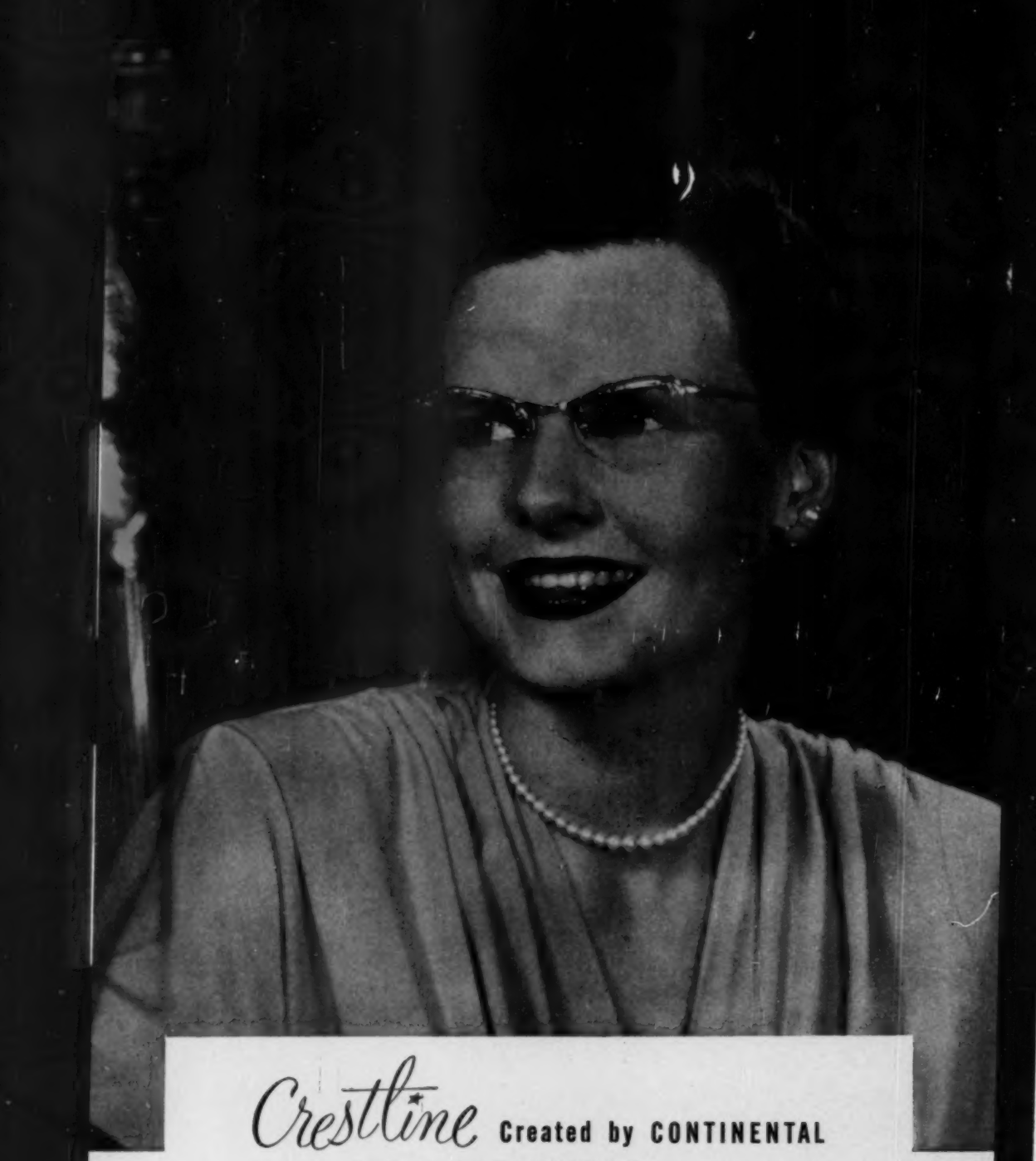

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Vol. 26 — No. 10

CONTENTS

ORIGINAL PAPERS

Readiness and Emotional Problems Associated with Reading Disabilities. Wilmot F. Schneider 413

Experiment on the Nature of the Retinal Image. James H. Grout 427

Orthoptics Specification by a Graphical Method. Henry W. Hofstetter 439

The Use of Telescopic Spectacles to Improve Visual Acuity Following Iridectomy — A Case Report. George C. Wise 445

Anisometropia—Case Report Demonstrating Effects of Improper Correction. Monroe J. Hirsch 447

EDITORIALS

The Heritage of Optometry. Carel C. Koch 451

OBITUARY

Rudolph Luneburg. Paul Boeder 454

TRANSACTIONS OF THE ACADEMY 455

CURRENT COMMENTS 457

BOOK REVIEW 460

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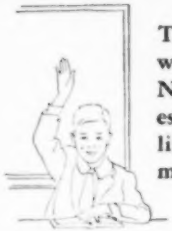

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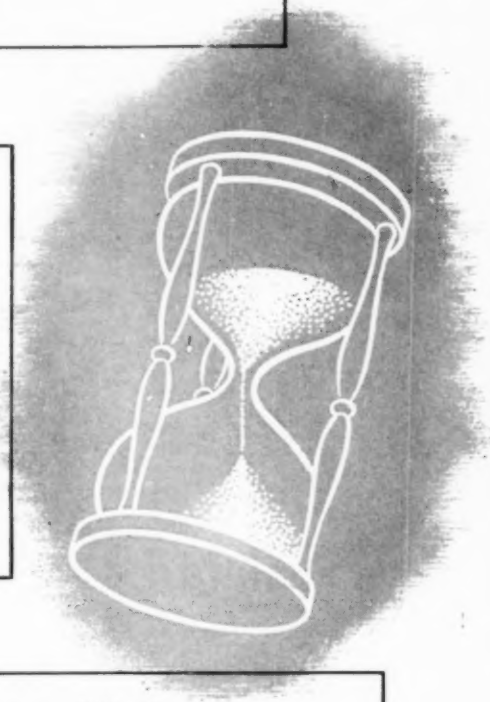

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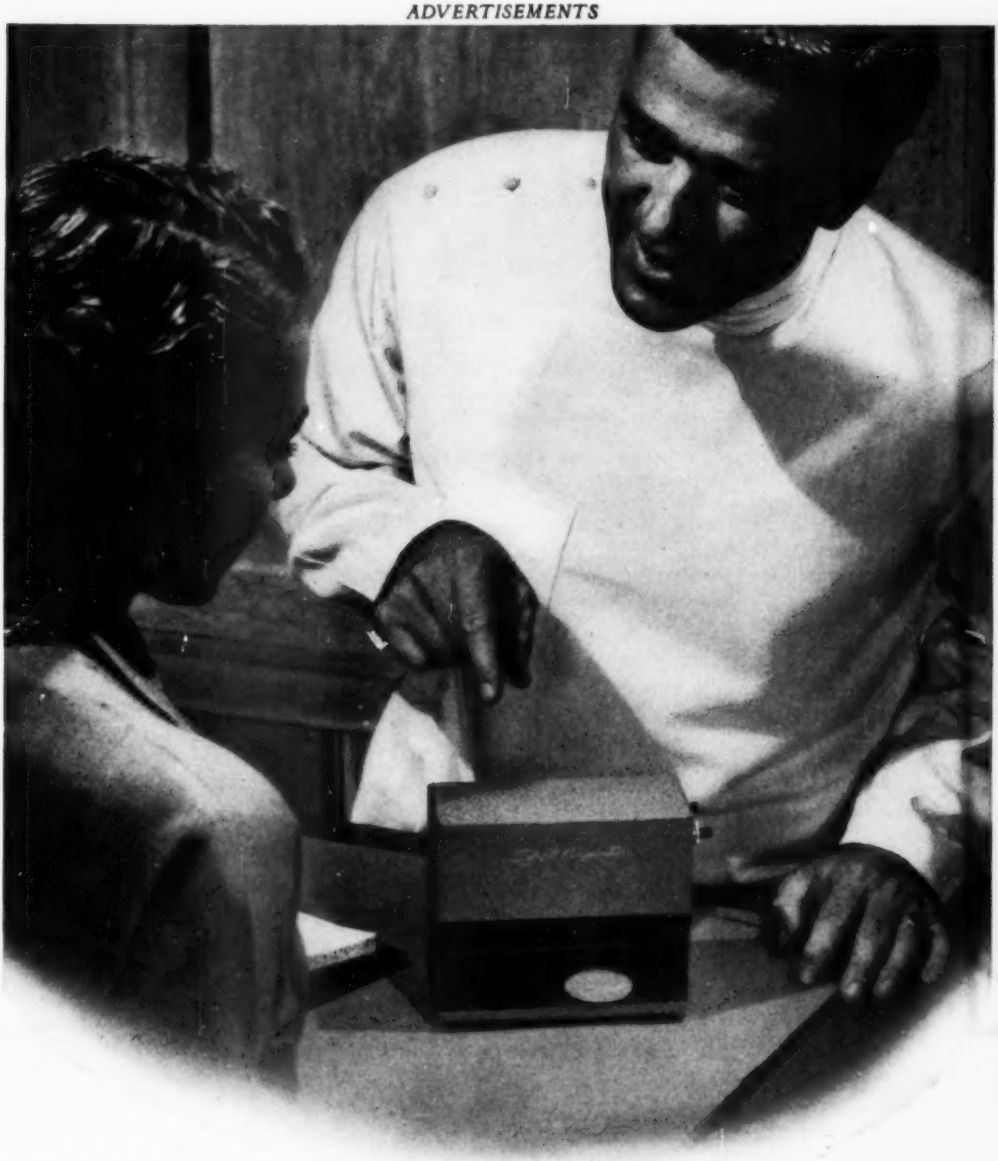

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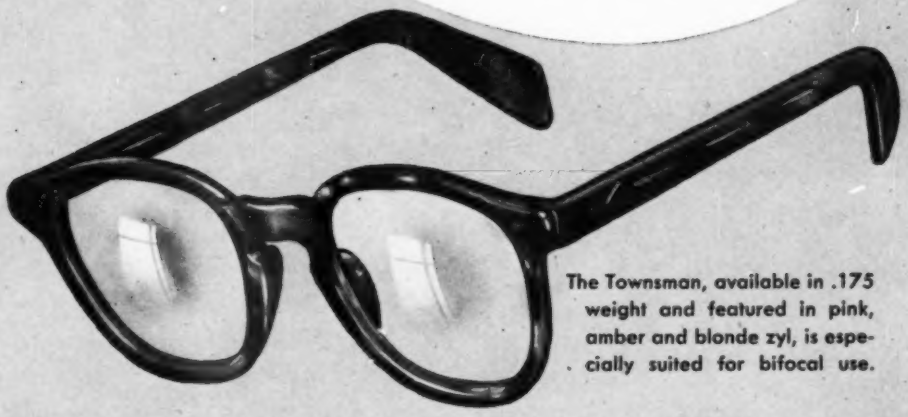

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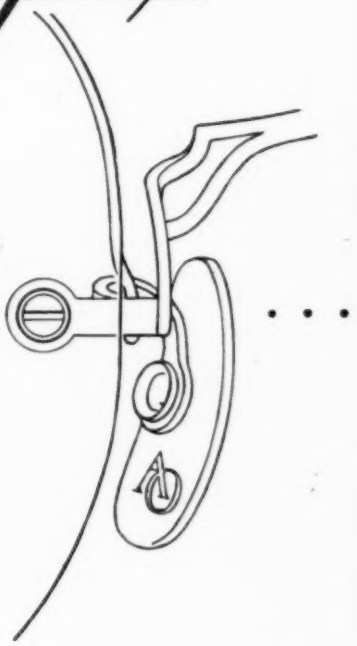

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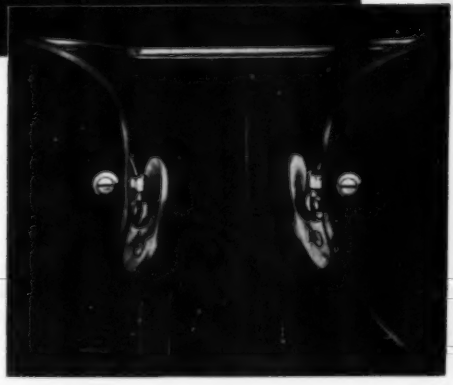

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Vol. 26 OCTOBER, 1949 No. 10

READINESS AND EMOTIONAL PROBLEMS ASSOCIATED WITH READING DISABILITIES*

Wilmot F. Schneider†
Shaker Heights, Ohio

It is a pleasure and a challenge to be called upon to present before a national group of eye specialists a subject which is and should be so important to the specialists whether they be educators, optometrists, parents or psychiatrists. The challenge should be that of PREVENTION. In many of our national meetings this year this idea of prevention in medicine, pediatrics, mental hygiene and other specialties has been stressed. Today I would like to lay emphasis on what constitutes the reading problem, what are some of the factors involved, the early recognition of the problem in the school child, and the combined role of the educator, eye specialist and psychiatrist in doing something about the problem. Our point of view should immediately become oriented to one of thinking about the child as a whole: not as a child with a great big EYE not functioning correctly, or as a child with a segment of the brain not registering the "3 R's," or as a child with an intangible "subconscious" somehow interfering with learning. Instead we must all work together to completely understand the psychobiological makeup of this child. Each one of us must contribute our full knowledge of each segment of this puzzle and then integrate our evaluations so that this child may function smoothly in the school system. We've got to get him to read!

Let us stop for a moment to ask ourselves whether we should allow ourselves to become unduly concerned about this problem of faulty reading. Surely "new and modern teaching methods" must be overcoming the difficulties of "poor reading." My answer to this would be that if I were a super-salesman and an organizer, I would be carrying a banner here about setting up a national FUND for research and "doing

*Read before the annual meeting of the American Academy of Optometry, Winston-Salem, North Carolina, December 6, 1948. For publication in the October, 1949, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†(M.D.). Child Psychiatrist.

something" about prevention: catching the problem down in kindergarten or preschool before it ever had a chance of getting to the psychiatrist. We have only to read our local newspapers and our technical journals to learn that poor reading, poor spelling and poor mathematics are things which are disturbing business men and forcing college educators to give their students elementary school remedial work.

It has been interesting to choose at random some of these accumulated articles to follow the trend of the "3 R's" in our elementary, high school and college graduates. In December, 1945, a Cleveland newspaper had an editorial containing the following: "An elementary observation, but many greater Cleveland high school graduates were reported ignorant of the ABC's and horrible spellers—so much so that a number of parents and men and women in business circles were talking yesterday about 'disturbing trends' in modern education." In October, 1941, *Time* reported the findings of Stella Center who has been doing a great deal with remedial reading in New York University's English Department. She gave insight into the difficulties which our armed forces had with inductees and their difficulties with or inability to read. She said, "We are a nation of sixth grade readers. It requires at least seventh grade skill to read a newspaper other than the tabloids. There are still sixteen million illiterates in the United States; they cannot read beyond the fourth grade level. Reading failure is a national problem." Just what this increase over the years means in percentages is brought out clearly by these educators. In December, 1933, Dr. Donald Durrell told members of the Boston Society of Psychiatry and Neurology, "An individual test survey of 1,130 children in the middle grades showed four per cent to have severe difficulties in reading. Boys having more difficulty than girls, the ratio being 2:1. Difficulties in reading affect the scores of intelligence tests very unfavorably; some being lowered as much as forty points in rating of the intelligence quotient." That was fifteen years ago! In 1941 Stella Center had found that reading problems affecting the child's school adjustment were about 25 per cent. This figure has been substantiated by child psychiatrists who were finding that many "problem" children referred to psychiatric clinics had school maladjustments associated with reading difficulties as the primary etiology for the behavior maladjustments. These findings were closely investigated and interpreted by Dr. Mary Preston of the San Francisco Child Guidance Clinic in her article, "Movie Horrors," and also by Dr. Lauretta Bender in Bellevue Hospital, New York, in an article about "fire setting" in children.

Where are we today? Has there evolved an integrated program of

physicians, educators and psychologists to the point of preventing this malignant emotional and didactic crippler? In the September, 1947 issue of *Hygeia* there is an article on "Remedial Reading" by Mrs. Dorothy Lightfoot whose private school tutoring and also private tutoring of children from more progressive and higher socio-economic elementary schools, should really make her know the figures. She stated, "If, as most educators believe, *one-third* of the children attending school regularly failed to learn to read satisfactorily, we need to find out why!" My own analysis of referrals from a public school system for the 1947-48 terms tended to corroborate this suggestion that 33 per cent of the children with school maladjustments had associated reading disabilities. The thing which should give pause to the eye specialist is the fact that the visualization, or "sight" method, has become uppermost in the teaching of the school fundamentals. The Drs. Bakwin[1] recently had a quite frank statement about this particular method of teaching reading in a *Journal of Pediatrics* article. They said, "One reason for the increased frequency of specific reading disability is the use of the 'sight' method for teaching children to read instead of the 'phonic' method." They give an answer to the oft heard question of parents, "Well, what was the number of children with reading problem in the 'good old days' before the 'sight method' was invented?" Dr. Bakwin says, "The condition is much less common in Germany, where the phonic method is used and where, in addition, the phonetic spelling is more rational." I might point out, however, that another factor must be remembered: Our state laws and often the child's parents insist upon much longer attendance in school than in the good old days of the phonic approach. In those days the child who didn't learn too readily dropped out of school much sooner to go to work. There was not nearly the present day opportunity for the percentages to accumulate.

Whatever factors are operating, we are faced with this problem and must turn our attention and energies to the causes and prevention. I have mentioned this matter of READINESS. What does this mean as far as the child and the eye specialist are concerned? Certainly we cannot consider a child "ready" for reading experience when he has a refractive error or some eye muscle imbalance causing eye strain. Several years ago Dr. Griffin Lewis, a classmate of my own father, said the statistics revealed that 25 per cent of the United States children have visual defects. Most important from the reading problem standpoint is his next assertion, "Doubtless 50 per cent more have latent troubles due to a low degree of far-sightedness or astigmatism of which they are unaware but

which sooner or later manifest themselves, possibly after irreparable damage has resulted." He carries out this idea about the farsighted child who over-accommodates to the point of a permanent strabismus and the danger of the establishment of monocular vision resulting from the cerebral suppression of the diplopia. All of us are too aware of how diplopia or the lack of good binocular vision will affect the child's school program. Yet the weakest point in the school program of testing visual acuity may lie in this particular area of far-sightedness and astigmatism. Here is where the eye specialist and the educator must work closely together to devise or utilize critically any existing tests which may reveal these serious defects. Dr. Constance McCullough[2] has brought out in her recent book, "Problems in the Improvement of Reading," "Farsightedness is the more grave defect (associated with reading difficulties) because it requires an exercise of the accommodation for near work which may produce ocular fatigue." Likewise, the imperativeness of an early recognition of these defects which may lead to strabismus, or the correction of other types of strabismus before the kindergarten age, seems to be universally recognized. This has been exhaustively investigated and described in Epstein's[3] 1948 book, "Strabismus—A Clinical Handbook."

It apparently does take a certain makeup for the doctor to successfully work with children. Since I see daily how tremendously upset a child can be when he has a reading problem, I can smile about, but heartily condone Dr. Smith's[4] "monkey-on-a-chandelier" philosophy which he brings out under a heading "Know Child Psychology." He expresses himself vehemently, "We see too many children with total amblyopia because some doctor found it inconvenient and time consuming to perform an accurate refraction upon or to treat an unruly child of 2 or 3 years. Any device, musical or electrical, that engages the tot's attention should be utilized to gain your diagnostic goal. Come down to the child's level—even if you have to get down on the floor to observe muscle actions or for ophthalmoscopy or retinoscopy." However, in all seriousness, the extreme need for the absolute evaluation of ocular acuity and muscle balance in the reading disability cases was brought out by Dr. George Park[5] who is one of the Reading Clinic "team" at the Dyslexia Memorial Institute at Northwestern University. In his recently published statistics about cases with reading difficulties he bears out the formerly mentioned 25 per cent with refractive errors, 22 per cent showed extremely weak stereopsis or none at all, "phorias have more significance, for 55 per cent of the patients were orthophoric. The remaining 45 per cent were heterophoric, and half of them were exophoric

for near (reading distance)." I cannot emphasize the latter findings too much as I can well remember three psychiatric patients who were exceedingly hyperkinetic in behavior and dullards in school performance until an exophoria had been operatively corrected. Dr. Park clearly indicates the need for the close co-ordination of the efforts of the educator and the eye man when he states, "Orthoptic treatments were recommended in 52 per cent of our cases."

So much for your part in getting the preschool child "ready" for his reading experience. You are really more fortunate in having the public accept what must be done about the eyes with a great deal more willingness than John Q. accepts what the educators have to say about *when* the child shall start to read. There is a real storm when the educator tells a parent that his child may not start to read right off the bat in first grade. This is indeed heresy and it will take more years of reeducation about behavior problems arising from parental forcing of such experiences on the poor innocents. Mr. William Kottmeyer, Director of the St. Louis Reading Clinic reported his petulant experiences in *Collier's* (11-30-46). He had found after testing four thousand first graders for "readiness" that one-third were not ready at all. When he ruled that these children should not get any reading instruction at all but that they should be given kindergarten activities and physical build-up programs. "How some of the parents yelled!" He attempted to sublimate the parental ire against him and his program by giving the following most pertinent suggestions. "Let your children have the experiences he will *read* about in primers. Take him on a picnic . . . the story book kids are always having picnics. Take him to a farm, a zoo, the grocery store, the post office, the fire house; teach him 'stop' and 'go' signs and his own address. Read him stories, teach him rhymes, and above all answer all his questions." Actually Mr. Kottmeyer is stating a courageous position and pointing the way to more stable mental hygiene principles when he says, "St. Louis seven year olds are often passed to the second grade whether or not they have started on reading, and, there again, they are given only such work as they are ready for. Grade divisions are getting blurred in St. Louis. Some eight year olds there have not yet been exposed to a primer."

We see that Mr. Kottmeyer is speaking in terms of "experience" and also maturity for greater experiences. In my own psychiatric work there are times when I am sorely pressed by parents to help them force their children into an advanced grade in spite of the board of education recommendations. The parents become too frustrated when they have an ego-deflation brought on by the failure of one of their children to

progress at the commonly accepted speed. In the process of reeducating the parents about how their child is made up I have often referred them to Mrs. Lightfoot's concise article about this phase. She has brought out, "As your child starts to school it is important to remember that it is not to be expected that all children are ready to begin reading just because they are six years old. Most schools are now doing 'reading readiness' work at the beginning of the first grade. Some children have reading problems because they were started before they were mature enough physically, mentally and emotionally to profit from reading instruction. Other children who talk 'baby talk', have not had the experiences that they will read about in their first books or have too short a span of attention. Some, particularly if they have had no kindergarten experience, are too insecure in their relations with other children and too distracted by them to concentrate on reading."

Thus it is seen that emphasis is being placed on this psychobiological makeup of the child and another interesting concept has been brought up. This is the matter of immaturity not only in the reading area but also as this pertains to speech. There is a growing emphasis on this concept that speech and reading development may be closely related. Thus far I have avoided the issue of *laterality* which has provoked quite a controversy among educators, psychiatrists, neurologists and speech and reading therapists. The Drs. Orton, Blau and Wile have contributed erudite volumes which pretty well exhaust the emotional and neurological implications of handedness and eyedness and how these may contribute to speech and reading disabilities. Recently Dr. Richard Eustis[4] has brought out the behavior problem implications of these "language disabilities:" his experiences have come through remedial work at the Language Clinic at Massachusetts General Hospital. He points out, "Many a healthy and intelligent person has been forced to modify his plans for the future because of defective speech or because he found it impossible to absorb knowledge from books fast enough to keep up with his school or college program." His neurologic interpretation of confused laterality and immaturity are important to us from the standpoint of "readiness." His findings have shown that there may actually be a correlation of five "apparently unrelated" symptoms: "Bodily clumsiness, left handedness and ambidexterity, late development of speech, lisping and stuttering and specific reading disability." He feels that these diverse bodily functions represent a rather specialized delay in development: that "neuromuscular maturation and myelination are closely associated in the growing infant and young child." Certainly the eye specialist knows that there is the slow maturation in

the development of visualization and later fusion. In the general "developmental phases" of sitting, walking, talking and toileting there is this individual growth pattern which is so well depicted in the books of Drs. Gessell and Aldrich. When we realize as specialists and educators that there is this real individuation, we are then in a position to advise children about school placements. We know that readiness and maturity are not things which we can push. Here we can truthfully say that the child "will grow into it!" Readiness in these developmental areas is very much akin to the readiness which is needed for proper speech development and for proper reading ability.

Dr. Abram Blau[7] brings out the uncertainty of spatial relationship as a certain part of the child's lack of readiness for the reading experience. In other words, this confusion between the right-left and the left-right directions. The type of difficulty which you would turn over to your orthoptic technician for correction in the office. When there is this confusion in eye-hand direction, those children who are not ready for the "sight" method have their reversals. Some of them may correct this within a short time without resorting to the phonic approach. Others, however, have a prolonged period of ambilaterality in their early childhood and in these it seems to be associated with the slower neuromuscular maturation. Certainly the longer this period is prolonged, the greater is the confusion; the greater the danger that the reversals will persist to a point where reading will be learned very slowly and may well become associated with emotional problems and also stuttering.

It is thus obvious that the educator and psychiatrist may frequently turn to the eye specialist for the solution to the problem of confused laterality. At least we are all in agreement that we would prefer to have the child all *one-sided* when we are working in the remedial reading and speech fields. Thus when we are confronted with a problem in a child who shows this confused laterality with the crossed hand and eye dominance, we must know what the optometrist or oculist has to say about refractive errors or muscle imbalances. Is there something handicapping the dominant eye so that the non-dominant eye is functioning? Which should be the dominant eye? Must we change handedness from the one which now tests as dominant to the one which will be associated with the dominant eye (or at least the eye which does not have any pathological changes)? These are some of the problems which we must work out together. Since there are many of you who have to work with the strabismus associated with brain injury, I would like to interpolate an interesting statement which Dr. Winthrop Phelps[8] made

at the Woods School meeting in 1946. He urged in his discussion of the management of the child with hemiplegia that "when the dominant hand is handicapped, no exercise whatsoever should be given it." He believes that manipulation of the affected limb interferes with the development of cerebral dominance on the uninjured side of the brain. In his experience, mental retardation, speech difficulties, seizures, and behavior disorders of all types are much more common in children with right hemiplegia than in those with left. Perhaps this viewpoint offers a challenge to the extreme caution which must be exercised in recommending orthoptic training or doing operative procedures upon the "brain injured child." In the psychiatric field these children offer a tremendous challenge to ingenuity in remedial reading and speech and in the matter of proper school and grade placement. It is thus wisely that we approach the child as a total individual: not just eyes, ears, teeth, an endocrine disorder or allergy problem. We see him as a whole human being in whom some part-dysfunction has temporarily or permanently disturbed his smooth integration.

EMOTIONAL PROBLEMS

Up to this point I have suggested wherein may arise these problems. I have tried to accentuate the concept of prevention of problems before they become overt. When we can marshal the knowledge of the specialties, we have given educators and parents working knowledge and tools through which they can more intelligently accept their children with their variable emotional, physical and intellectual capacities. Emotional problems can be averted to a great extent when the parents become so educated that they do accept the child with his own capacity or disabilities. When the child is so accepted rather than having the parents place their own ego and goals above the child's capacity, we may not meet the problems which Drs. Preston and Bender have discussed about fire setting, delinquencies, sadism and acute anxiety attacks. Such problems which I have mentioned as being associated with reading disabilities in a surprisingly large per cent.

Unfortunately the behavior problems associated with reading difficulties do not present themselves to the child psychiatrist with the convenient label, "This is due to reading troubles." So often no clue to the difficulty is given until detailed testing has been done. Often the child has been able to mask reading difficulties through a combination of high intelligence and good auditory recall. This combination so often gives the typical picture of the child who has progressed well in first grade or possibly a half of second grade. His marks gradually decline as there is more and more need for really reading the words, rather

than repeating back a story which has been stimulated by the picture on the page as the clue. Most often the child and the parent do not recognize what the difficulty is and increasing pressure is put on the child. It is this pressure to produce which leads to the behavior problems which I see frequently, not only associated with reading difficulties but in other areas also. The child who does not eat, who does not sleep or who does not associate with other children, as well as parents expect, begins to have more and more pressure placed on him to do these things. The most frequently seen behavior occurring in such a situation is the arising or accentuation of inherent and conditioned anxieties and frustrations.

The child psychiatrist knows only too well that he is dealing with the total, integrated psychobiological unit. He knows that this is made up of inherited trends in the emotional, intellectual and physical realms and that this unit, or the child, is acted upon by the total environment and in turn reacts upon the total environment. In none of our work with children can this integration and conditioning be overlooked. We know only too well that there does not exist any longer the older thought of "parallelism" of mind and body. Consequently we have to look back to what the parents and grandparents are like before we can understand the degree of anxieties and frustrations which may take place in these children and give rise to the symptoms which will be mentioned. How the child reacts to his anxieties will depend a great deal upon his "erlebnistypus." In other words, his actions will depend upon the degree of introversion or extroversion which is present. In order to give a more graphic view of the types of expected behavior from either type, I have set up a very simple parallel table of behavior.

Introvert	*Extrovert*
(a) Somatic Symptoms—Escapism	(a) Temper outbursts
(b) Refusal to attend school	(b) Truancy
(c) Anxieties	(c) Anxieties
(1) Sleep disturbances (acute)	(1) Hysterias
(2) Compulsion vomiting (chronic)	(2) Blaming others (not to be confused with psychopathy)
(3) Radio and movie addiction	(3) Fire setting; stealing; sadistic actions.

When the parent has described to the psychiatrist the behavior, as may be indicated in the above outline, it is often quite difficult for the parent to realize that a reading disability may be the basis for the overt behavior. Too frequently the parent feels that the child is just "not trying to do the school work;" just the same as the parent feels the

child is not trying to adjust to the parent and school demands. I have interviewed child after child who will bring out to me the really pitiful story, "Doctor, I really am *trying* but nobody believes me." Likewise the child's oft repeated question, "Doctor, am I right? Did I get the one right?" speaks volumes for the child who is really trying and who is tremendously frustrated and tremendously anxious about his own achievement. The perfectionistic parent who exacts and demands a hundred per cent perfection from himself and from the children too frequently overlooks the fact that the child himself may be a perfectionist. This child in his school work tries to keep up to his *own* demands. As he sees that he is not achieving in school, he becomes more and more frustrated. Often this child becomes so involved in his own compulsive uncertainty about "Am I right? Am I wrong?" that he is unable to achieve anything. He is unable to volunteer in class because he feels that he must have everything exactly right before he can tell the teacher an answer. His seat work is so often the besmudged, erased and re-erased type of paper which the teacher may refuse to accept. Actually this perfectionistic child is so driven by his own inner demands that he will not submit anything until it meets his own standards. A behavior like this forces us to return to the question over and again, "Why does he behave as he does?"

Until we can understand the mechanism of parental behavior (see: Dr. Edward Strecker's book "Their Mother's Sons," J. B. Lippincott Company, Philadelphia, 1946) we cannot entirely understand the child's reactions. I often feel sorry for the child with reading difficulties whose mother is a former school teacher. It has been said, "The fury of the school teacher-parent knoweth no bounds. She beats, hovers over by the hour, deprives, humiliates." Simply stating the mechanism in her case we see the frustration brought out in her statement, "That this should ever happen to me!" This child's problem has become too personal for the parent to handle. It is all very well to say that "the parent should be informed how to carry on remedial reading techniques within the home" so that they can "help." It has been my experience, when the parent is dealing with the true specific reading disability, that the parent loses perspective and views the problem emotionally rather than intellectually. Consequently the best remedial reading teacher may not be the best one for her *own* child. Just the other day I had a teacher-mother say to me, "Doctor, I went over those spelling words a hundred times the night before. The next morning when I asked her the simplest words she did not know them." All of us are only too much aware that the parent can take just so

much of this and then emotional pressures are put on to the point where fatigue, irritability and resultant temper tantrums are displayed by both the parent and the child. Grace Arthur[9] brings this out only too clearly in her latest book, "Tutoring as Therapy." In her preface the concluding sentence is as follows: "The value of tutoring does not consist in giving individual attention for its own sake but in adapting the teaching to the specific needs of the person taught." The mechanism of the professional person-parent is so often revealed in the remark "I'll make a doctor or a lawyer or a social worker out of him or her if it kills me." We can only feel sorry for this child whose intellectual capacity may not fit him for the goal to which the parent is driving him, or, there may be a reading disability which will keep him from reading rapidly enough the minutiae involved in all professional reading. We must also feel sorry for the bewildered "average" parent who is faced with the conflicting school remarks of "dumbness"—or—"he could be the brightest in the class if he only would try!"

The role of the child psychiatrist is very much that of the old "family doctor." It is his job of understanding the child as a whole: integrating the findings of the other specialists with what he knows about the child's physical, emotional and intellectual make up from his own studies. It is through this integration and evaluation of even the "small defects" that the adjustment of this child to the school situation may be achieved. Often, too, the child psychiatrist stands in the position of a liaison officer to interpret parent and home to the school as well as getting across what the school may be attempting for the child's own welfare.

Should the child have some central nervous system disturbance the psychiatrist can help the school greatly in ascertaining why this child is not succeeding. We know only too well that central nervous system damage can produce very wide disturbances in thinking and in the emotional adjustment. We do not need to have overt convulsions in a child to have his total adjustment to society disturbed. We know only too well that other types of cerebral dysrhythmias, as discovered by the electroencephalographic technique, may produce just as severe maladjustments. Many neurologists point out how central nervous system damage can produce total bodily changes such as seen in the overly fat, clumsy child with specific reading, arithmetic and writing disabilities. I shall only point to two books which should be a must reading for parents and educators who are confronted with the child having difficulties in these three areas. In 1937 Elizabeth Lord published her short book about "Children Handicapped by Cerebral Palsy" (The

Commonwealth Fund, New York, 1937). Many a parent and educator may say that there are so few of this particular type to deal with that it hardly would fit into the general scheme of school problems. I can only answer this by saying that minor cerebral damage may not give such overt signs as "palsy" but that they can contribute greatly to the overactivity, short attention span, distractibility and poorer progress along the three mentioned lines of school activity. This particular point of view of minor head injuries or central nervous system injuries of prenatal and postnatal types is discussed fully in Dr. Alfred Strauss' book, "Psychopathology and Education of the Brain Injured Child." Rather than take any illustration from his book I would prefer to take a typical case with which I have to deal day after day. I will try to bring out in this brief case illustration the problems confronting the child, the parent and the school and what may have to be done to remedy his own particular difficulties.

Jane S. (No. 938) was 13 years old when first examined. She was only in 4th grade instead of 7th grade. Moving from one city to another had exposed her to different educational systems yet she had "not learned to read well." She was reported to still have word reversals; she was slow to grasp her school work; she would fail terribly in final examinations (the marks from the school report showed from 30-60 in finals); the school teachers have to "hang over her to get her to do the work." The mother describes the girl as "flighty and scatter-brained." The teacher says that the girl "tries hard"; "G's" have been obtained in conduct and health habits.

As the history strongly suggests the poor concentration, distractibility, inability to apply unless constant pressure by the teacher is given, "panic" type of thinking under the strain of examinations, a careful review of the heredity and early infancy history was made. The familial history pointed to two cases of progressive sclerosis; one brother was ambidextrous; the father was an extremely ambitious man who was rather a mathematical genius. Perfectionism, drive and migraine were present in the mother. Necessarily Jane's school retardation was a severe blow to these parents. Jane's "Past History" revealed that she had some eye defect at birth leaving only 1/3 vision of the left. Glasses had been given at 5 years. The developmental history suggested that this girl was doubtlessly of normal or advanced intelligence. Her real troubles began with school. Although contagious disease and head injuries did not complicate her early course, she did have a "terribly severe attack" of whooping cough at $10\frac{1}{2}$ years. This disease contributed further to the central nervous system involvement in this case.

The examination showed that Jane at 13 was a gangling, self-conscious, sensitive adolescent. Her gross motor control was seen to be good, as she could excel in swimming, tennis and baseball. She felt "terribly" because she was doing poor school work about which other children teased her as well as about her grade placement. The home attitude toward her was well illustrated in her definition of the Binet vocabulary word "roar": "My grandmother roars at me and sometimes mother and father." The revised Stanford-Binet, Form L, showed a Mental age of 11 years 10 months and an I.Q. of 91. The "paper cutting" and "designs" showed poor visuo-spatial orientation with design "a" done upside down and "b" with the inner "box" shifted to the left. Jane was entirely right sided. The "reading recall" of year X showed the slow, hesitating reading, scattered recall and typical errors of the child with strephosymbolia.

The physical examination revealed severe hyperopic astigmatic, repetitious ties and accentuated tendon reflexes. Because of the better application during the testing (undistracted, individual work) as compared with the school behavior, the poorer writing as compared with better gross motor control, the poorer visuo-spatial integration, the strephosymbolia and reflex changes, a mild encephalopathy was postulated. A change of school systems was recommended as well as remedial reading by a person skilled in dealing with neurological defects contributing to reading disabilities. This program

definitely reduced the girl's tension, brought about better application in school and erased the almost choreiform overactivity.

Four years later Jane was referred from junior high school for restudy. In these intervening years she had "struggled" through to eighth grade despite group tests showing I.Q. equivalents of 73 and 69 and a reading grade level of 4.9. It was felt that she had obtained "D" and "C" grades only through "her own drive and effort." The big question was, "What to do with her and high school?" The father pretty clearly gave me the answer to this, "She's too big and too old for high school now. Since sixteen she's worked part time at one of the department stores downtown accurately handling a salesbook of over a hundred dollars. She has learned the comptometer in my office and is taking typing in a night school. I'm taking her out of public school and putting her in a private business school!"

It was interesting to again see Jane. She was now a well-developed, self-poised and self-confident young woman. Her social confidence was normal for the age. Curiosity forced me to readminister the revised Stanford-Binet, Form L, again. This time her mental age was 16 years 3 months and the I.Q. 108. No distractibility or tics was apparent. Yet the Binet brought out even more clearly than before the complete block in mathematics; the simplest subtraction problems were pretty impossible. Under some emotional tension (awareness of failures) it was possible to see the extreme reduction in application of good thinking ability, the emotional ability, the slower reaction time to new thinking situations, the sticky, perseveration of ideas, the inferiority and anger at herself for failures. Outstanding was *rote memory*. This is a thing so often seen in children with similar central nervous system changes: the thing which so often confuses parents and teachers and leads to false concepts about superior ability. It may be this rote memory which will be the continued salvation for this girl. Her gross motor control has allowed her to achieve and become superior in athletics. Her finer motor control (poorer writing) has not apparently handicapped her for typing. Her rote memory may fit her to become a stenographer who can maintain herself in society.

After having examined, as psychobiological units, many unfortunate and maladjusted children with their reading difficulties, I can only conclude that reading disabilities will always be with us to a certain degree until we can create babies in the true Huxleyan, "Brave New World," fashion. Until then we will still be faced with teaching children whose central nervous systems have been imperiled by such things as rubella during pregnancy, Rh incompatibilities and resultant "kern icterus," endocrine abnormalities, umbilical cords around necks with sequellae due to anoxia, inherited dysrhythmias, and even treponema pallidum or toxoplasmosis. As long as we are human beings, we will continue to produce more human beings who will challenge every combined effort and wholesome cooperation of every professional man and educator. Through our efforts to train and educate these children in later life we must constantly watch for methods which will help parents raise these children in early life. Our preventive mental hygiene efforts must be directed toward early recognition of incipient problems and advancing techniques for adapting the child with her or his psychobiological capacity, or lack of capacity, rapidly to the demands and ever increasing tensions of society.

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ABSTRACTS

PUPIL SIZE IN AMETROPIA. Monroe J. Hirsch and Frank W. Weymouth. J. Applied Physiology. 1(9). 646-48. March 1949.

A common assumption is that the pupil size in myopic eyes is larger, and that in hyperopic eyes it is smaller, than in emmetropic eyes. The purpose of this study is (1) to determine if there is any relationship between pupil size and refractive state and (2) if the relationship is present only when the apparent pupil size is considered, as implied by Tscherning.

Measurements of apparent pupil size and refractive state were made on 266 students (532 eyes) and a coefficient of correlation of—0.243 was found between the refractive state and the pupil diameter. This indicates association between hyperopic and small pupil or myopic and large pupil.

The apparent pupil size is larger than the real pupil size and the difference depends upon the corneal power and the depth of the anterior chamber. Since myopia is associated with a greater corneal power and a larger chamber depth, the apparent size of the pupil can be expected to be greater than the real pupil size as pointed out by Tscherning. By statistical treatment of the data using Stenstrom's figures for the average corneal powers and anterior chamber depths for the various refractive states, the average real pupil sizes were computed. The coefficient of correlation (—0.104) between real pupil size and refractive state was considerably lower than that for apparent pupil size and refractive state.

The authors concluded that there seems to be a real basis for the common opinion that pupil size varies with types of ametropia—the myopic eyes having the larger apparent pupil size, in general. However, the great variability in pupil size for any given refractive state does not permit much prediction in individual cases. Tscherning's view that differences in apparent pupil size between myopes and hyperopes is due to the greater magnification in the former case is supported by the present findings which indicate that while 6 per cent of the variability in *apparent* pupil size is associated with refractive state, only about one per cent of the variability in *real* pupil size is so associated.

R. E. B.

EXPERIMENT ON THE NATURE OF THE RETINAL IMAGE*

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The experiment covered by this paper is designed to make an unbiased investigation of the nature of the controversial thing known as a retinal image. The retinal image has been praised and condemned for a good many years, with most of the observations offered based upon past teachings, extractions from data which happened to agree with the observer's philosophy, and pure conjecture. The experiment has as its purpose the demonstration of the physical nature of the retinal image formed, including a study of the effect of the optical aberrations of the eye upon this image and the effect of changes in lens power and fixation distance as these factors affect the observable characteristics of the image.

Let me speak for a moment on two extreme schools of thought as they deal with the subject. The classical viewpoint of retinal imagery stated that the retinal image was a perfectly precise optical reproduction of the object and that the appearance of the object as seen by the individual was an exact duplicate of this image. Under this concept, it would follow that if a person should observe an astigmatic dial with, for example, the vertical line more blurred than the rest, it was believed that the image on the retina likewise appeared with the vertical line of this image more blurred than the rest, and more important, that the *degree* of blur of the image formed would equal the *degree* of blur of the target as seen by the observer. The image, therefore, was considered simply as a miniature of the object as seen.

At the other extreme of this view, it has become the vogue in certain quarters for the past five or six years, to refer to this retinal image as no more than a "blob" or "patch" of light, such an image having no optical characteristics whatsoever. Certain personal interpretations have been put upon the work of Gullstrand as the basis for this latter view.

Gullstrand completed a most complex mathematical study of the aberrations of the human eye around the turn of the century, and stated, among other things, that with a dilated pupil, the human eye possesses

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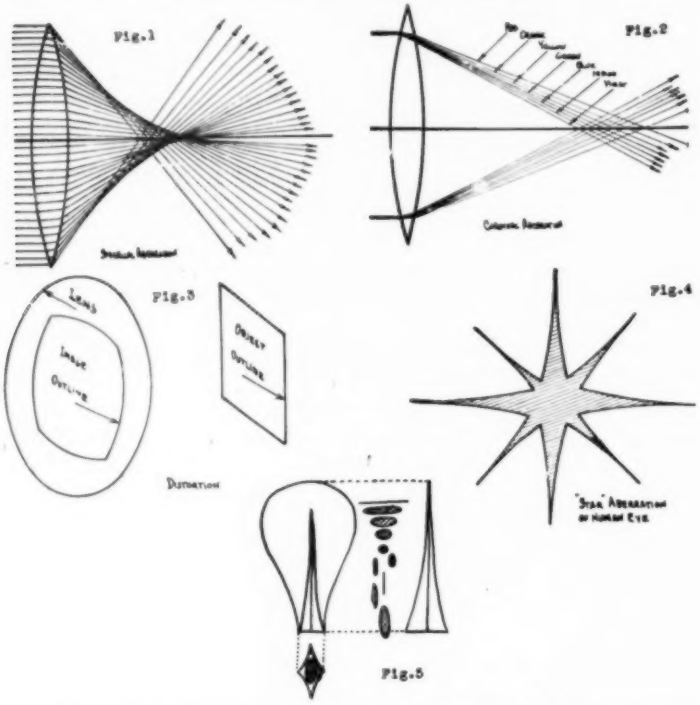
about 1.50 D. of spherical aberration so that a caustic surface is formed by light entering the eye rather than the classical cone of light associated with an aberration-free convex lens system. Figure 1.



The second aberration which we should consider is chromatic in nature. We are all familiar with the chromatic aberration produced by lenses. This results from the fact that the index of refraction for a given medium varies inversely as the wave length of light passing through that medium. This means that the index is least for the long wave lengths such as red and orange, and greatest for the short wave lengths such as blue and violet. The result is a number of foci being formed when a parallel beam of white light is passed through a convex lens system. Figure 2. The scope of this aberration in the human eye is of no small amount, measuring approximately 2.00 D. between the focal point for red and that for violet. The cobalt blue glass test and the very common red-green test are clinical manifestations of this aberration. It can also be shown by the use of proper red and blue filters to produce

highly saturated colors, that a marked change in accommodation is necessary to first focus print superimposed on the red field and then that superimposed upon the blue field. As the subject alternately views these two colored fields the amount and type of change in accommodation can be ascertained by the interposing of plus and minus lenses before the eyes.

A third aberration is known as distortion. Because of the varying magnifying power of a plus lens through points selected progressively from the center to the periphery of this lens, we will find that an object of square shape will have in its image a bulging effect as shown in Figure 3. This aberration is quite apparent in the photographs which will follow.

An aberration peculiar to an eye was described by Gullstrand. Radial ridges, present within the crystalline lens as areas of different optical indices, were calculated to produce a serrated surface to the caustic described under spherical aberration. This would cause an image of a point to appear not as a point, but as a bright spot having in the well-formed eye, eight ray-like projections extending from it much in the same manner that the spokes of an astigmatic dial radiate from the center. Figure 4. This phenomenon may be appreciated by viewing any small source of light such as an ophthalmoscope bulb placed in a dark room with the observer. This effect can be enhanced by the addition of a small amount of plus so that the observer becomes artificially myopic. The aberration has been recognized by artists for many years as they invariably portray a star not as the round dot that it actually is, but as what we have come to know as a star. We shall refer to this aberration as the star aberration.

If we now consider the 1.50 D. of spherical aberration with the resultant caustic surface, add to this the fact that the star aberration brings about a serrated or saw-tooth characteristic to the caustic, add still further the 2 D. of chromatic aberration which means that there will be an individual serrated caustic surface for each individual wave length, and then include the aberration known as distortion, and it will be readily seen that the tracing of the passage of rays within the human eye is an amazingly complex problem. As a matter of fact, the classical Sturm's conoid in the human eye, if we consider the overall form as produced by the rays, looks like something entirely foreign to the textbook pictures. Figure 5 illustrates a much simplified view of this conoid. Keep in mind, however, that although the overall shape may look something like a "beaver's tail," the light distribution throughout that form will still give us in cross-section a fairly good representation of the ovals, circle, and lines with which we are familiar.

I believe that with a little more time and the motivation to do so, I might very well convince a good number of you that imagery in the optical sense must indeed be an impossibility. On the other hand, the fact that we can produce changes in the nature of a person's subjective seeing, with such changes being predictable, and such predictions based upon the laws of image formation, presents strong support of the original physical concept first described. In other words, changes in the appearance of an astigmatic dial or of a group of letters can be predicted on optical grounds *as if* our eye actually was an aberration-free, precisely accurate, lens system. In addition, the fact that a point of light, when observed in a dark room appears as a star, when indeed the retinal image *is* a star, offers strong argument in favor of the physical concept.

As in the case with most extreme schools of thought, neither one is wholly consistent with fact. You will be left to judge the degree in which each concept is fallacious.

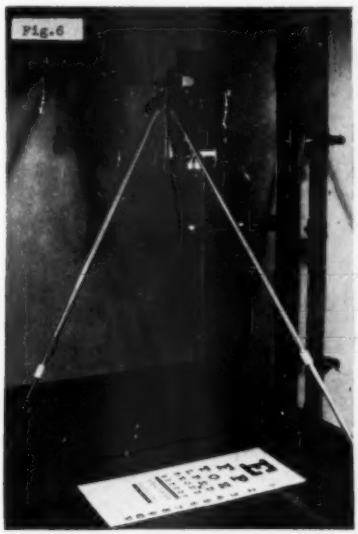
Let it be said here and now that the writer is not making any attempt to prove one belief or the other. Furthermore, the results of the experiment are, in the writer's opinion, no way controversial with respect to our concept of vision. By this we mean that the learned and maturational process by which we have a true three dimensional interpretation and projection of our environment, which goes by the name of "vision," is a subject much more complex and far-reaching than simply a study in imagery would expose. Instead, we are concerned simply with investigating the truth as to the nature of this stimulus which goes by the name of "retinal image." By this means we are better able to understand some of the basic concepts in theoretical optometry rather than allowing that subject to remain such a popular one for philosophizing.

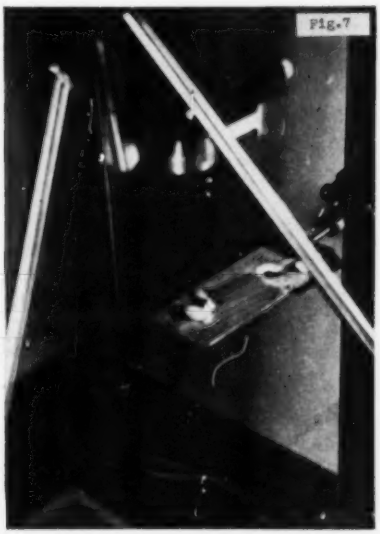
The experiments were conducted as follows: We obtained from the slaughter houses a number of sheep's eyes which were delivered to the college in physiological salt solution. These eyes were received fresh, as they had been enucleated within minutes after the animal was killed. Injections of cocaine were administered into the anterior chambers immediately before enucleation, so that the pupils were dilated. The pupils of the eyes used were of a fairly constant size, and averaged 8x12.5 mm. This difference in the pupil diameters results from the fact that the sheep's eye normally has a slit pupil.

The sclera and choroid were carefully dissected from the back of the eye to leave an open square with the retina exposed. Although images were observed upon the retina itself as a screen, difficulty was encountered as the retina was beginning to turn gray and translucent.

Because of this, the retinal film was peeled away, leaving the posterior surface of the vitreous body exposed. It was at this surface which had formerly been in contact with the retina, that we produced the images which are to be described. The experiment also included the observation and photography of images focused upon a finely frosted disc of glass which was placed in contact with the vitreous body.

In a small holder about ¼" thick, a concave beveled opening was cut. The eye was placed cornea down so that the holder supported the eyeball, while, at the same time, the cornea was exposed through the circular opening in the holder, and therefore, presented the exposed vitreous body facing upward. Light sources or objects used were an astigmatic dial, a regular Snellen test card, and the faces of several of the





experimenters. The objects were illuminated by two No. 2 photoflood lamps. A graflex camera, employing a ground glass screen for focusing was positioned on a tripod directly above the eye, with the lens, of course, pointing down, so that photographs of the image as seen at the posterior surface of the vitreous body could be obtained. Figures 6 and 7.

Figures 8, 9* and 10, are three of the photographs taken. You will note the following characteristics in these pictures. The astigmatic dial

*The Snellen chart used for this photograph was laterally inverted such as those employed for viewing through a mirror. This chart when placed upside down accounts for the photographic results.

will show the three individual lines in some of the spokes. Any magnifying glass on the original photographic print will make this quite apparent. The Snellen test card is easily read as you can see, and the face is recognized as being a picture of the writer. You will find the optical aberration known as "distortion" quite apparent in the pictures of the Snellen card and of the face. This distortion is of the "barrel" type and accounts for the rounded shape of the Snellen test card and the bulging appearance of the face. This is, of course, a typical aberration of any large aperture and high power convex lens system.

The objects from which the pictures described above were obtained, were placed at a distance of 30" from the cornea of the sheep's eye. The camera lens was positioned 8½" above the image plane, which was the posterior surface of the vitreous body, and which, for the focal length camera used, gave unit magnification. The pupil size, as men-

tioned previously equalled 8x12.5 mm. Furthermore, I would like to explain that the photographs do not do justice to the images because of the amateur level of our experience as photographers.

Let us now look at another aspect of the experiment. First consider the known data on the aberrations of the eye. As mentioned previously in this paper, the work of Gullstrand serves as a basis for these facts. The spherical aberration of the eye is approximately 1.50 D. in range between the foci of the central and peripheral rays. This aberration will form what is known as a caustic surface rather than the convergent cone of light associated with aberration-free convex lens systems. The radial ridges of the lens then add a serrated or saw-toothed characteristic to this caustic surface, and if we then consider the chromatic aberration which amounts to about 2 D. between the red and blue foci, and realize

that we have, therefore, one of these serrated caustic surfaces for each individual wave length extending over this 2 D. range, it is evident that the tracing of the ray paths becomes most complex. The question then becomes, "How is it that with all these aberrations just described, we can account for an optical image which is far from poor as evidenced in the photographs submitted?" The answer is simple. The eye is a very short focal length system, and as such, these aberrations of 1.50 and 2 D. become relatively insignificant since the image planes for the various foci will differ by only a very small distance. Furthermore, the starlike radiations resulting from the lenticular ridges, for the most part, fall beneath the retinal threshold, and are visible to the common observer only under conditions of scotopic vision and a darkened field.

The very short focal length which reduces the effectiveness of the aberrations, in turn, accounts for the following observation. By placing a ground glass screen over the vitreous body to act as a retina, the experimenter held the eye with the cornea pointing toward various objects and viewed the inverted images formed on this screen. It was observed that although images of objects placed at any position from infinity to a fairly near distance were viewed, there was no change in the clarity of the focus insofar as could be observed by direct vision. In the same connection, the eye was again placed in the holder with the ground glass screen placed over the vitreous body, and a Snellen test card moved from a distance of 30" up toward the cornea while observation was made of the image formed. The image, of course, became larger as the object was brought closer, but so far as could be appreciated by direct vision, the image appeared to remain in focus until the test card was brought to within about 4" of the cornea, at which time a noticeable blur resulted. Additional experiments were performed in this connection. Spherical lenses were added in front of the cornea with the resulting change in the image observed. As near as we could judge, it required a power of about 6 D. before the image appeared to change in clarity upon the addition of these lenses. As would be expected, it required the same power cylinder, before an image of the astigmatic dial placed at 30" showed a difference in the clarity between the various lines of the dial.

The observations just described took place upon an image eight times as large than had the test cards been placed at 20 feet. This fact made these observations relatively gross.

It would be apparent at this stage of the investigation that the short focal length of the eye makes possible relatively great changes in object distance or lens power with only a slight change in image focus when this focus is judged *objectively*. One point should be made clear, how-

ever: it must be realized, that changes in clarity of focus, based upon the laws of optics *do*, of course, take place in this image as distance and lenses are changed. It is a correlation between these rather small changes in focus of the retinal image and the resulting change in subjective blur, as experienced by the subject, that becomes an important objective of this experiment.

For the sake of simplicity let us speak of the blur which may be created in the retinal image of the sheep's eye and which may be observed by an experimenter as an "objective blur." A blur such as occurs on a Snellen test card when a fogging lens is added to a patient's eye will be termed a "subjective blur."

The first step in illustrating the correlation between the objective blur and the subjective blur was performed as follows. The test targets were left at 30 inches from the sheep's cornea. It was at this object distance that the image photographs were obtained. It was also at this distance that it required a +6 D. lens to produce the first observable objective blur of the image of a Snellen test card. In keeping with these data, the experimenter placed the same Snellen test chart at the same distance from his face. Sufficient plus was added before his eye to take up the negative relative accommodation for that distance. It was found that a +1 sphere sufficed for this purpose. Now that accommodation could be ruled out, additional plus spheres were added with the resulting subjective blur observed. The following table lists the lens power added above the initial +1 sphere alongside the resulting degree of visual acuity barely obtainable.

+1.00	20 ft. letter
+2.00	20 ft. letter
+3.00	50 ft. letter
+4.00	70 ft. letter
+5.00	100 ft. letter
+6.00	200 ft. letter

It follows that the +6 lens which gave the first recognizable blur to the small lines of the objective image as observed on the sheep's retina, in turn blurred the experimenter subjectively, to a 200 foot letter. The conclusion to be drawn so far is simply that the correlation between the *degree* of blur of the subjective image and the *degree* of blur of the physical or objective image is far from a one to one relationship.

The next step in the experiment was designed to bring about test conditions more nearly like those associated with our standard distance acuity tests. Figure 11 diagrammatically illustrates the optical setup with which the remainder of the experiment was performed. Shown in this diagram is a Snellen test chart, a microscope, and a sheep's eye so

Fig.11

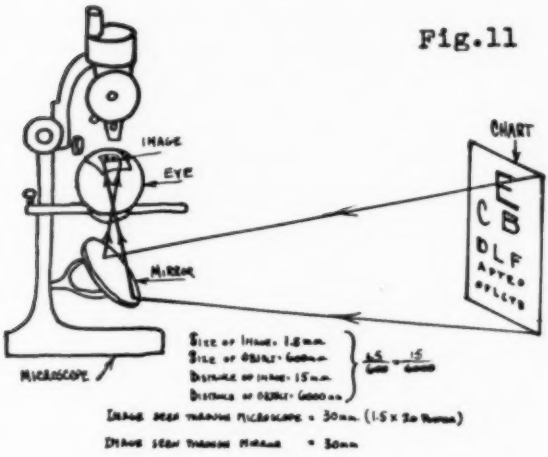
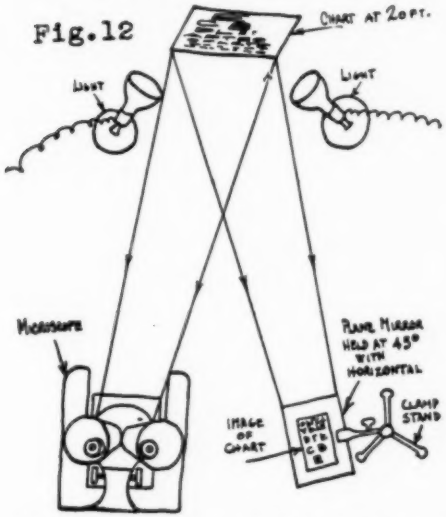


Fig.12



positioned that light from the chart, which was placed 20 feet away, will strike the plane mirror of the microscope and be reflected up into the eye so that a retinal image is formed. It can be seen from the diagram that an experimenter looking into the microscope can observe this retinal image under various degrees of magnification. It became the first objective to bring about magnification of this retinal image so that when it was

viewed through the microscope it would appear to be the same size as the actual Snellen test chart appeared to be, when viewed directly by the observer. To facilitate this comparison, it was found very advantageous to place a small plane mirror directly alongside the microscope. This mirror was clamped into a 45° position so that by looking directly down into it, an image of the Snellen test chart could be observed having the same size and optical characteristics as if the observer were looking directly at the chart. Figure 12.

By trying different magnifying powers in the microscope, equal sizes were obtained for the retinal image seen in the microscope and the image of the chart as seen in the plane mirror. A power of 20 diameters was used which gave an image in the microscope, when judged alongside a P. D. ruler, of about 30 mm. It is interesting to note that the retinal image of the Snellen test chart measured 1.5 mm. without magnification. We then measured the size of the chart and found it to be 60 cm., or 600 mm. The distance of the chart was 20 feet, or 6000 mm. If we assume that the sheep's eye approximates the human eye in that the distance from the nodal point to the retina equals 15 mm., we have a perfect proportion resulting. This is the regular magnification formula which states size of image : size of object :: distance of image : distance of object, or 1.5 : 600 :: 15 : 6000.

The ground glass screen was not used for this part of the experiment because of the grain which became very apparent when this 1.5 mm. retinal image was magnified to 30 mm. Instead, the microscope was focused for the plane of the real image in space, a procedure as optically valid as the use of a focusing screen. Because of the magnification, delicate adjustments were necessary. With one of the eyes under observation, however, the writer had the experience of reading all of the 25 foot line and missing but three letters in the 20 foot line. This becomes more remarkable when it is realized that the actual unmagnified image size of these 25 foot letters was only .027 mm. and the 20 foot letters were but .022 of a mm. in height. These figures were obtained by a simple proportion with the chart size known at 600 mm., the chart image size known as 1.5 mm., and the 20 and 25 foot letter sizes known as 8.724 mm., and 10.905 mm. respectively. Realize that the blur circle size must be extremely small to have made these very tiny images legible.

It next became our problem to show a relationship between degrees of blur when judged objectively versus degrees of blur subjectively. By the time the experiment had reached this stage, the best visual acuity that we could obtain through the microscope for the eye then in use, was

20/50. Lenses were added before the sheep's eye with the resulting change in objective blur noted and recorded by the observer looking through the microscope. These data are shown in the left-hand column of the table given below. Next, lenses were added to an emmetropic observer while he viewed the same Snellen test chart at 20 feet. The results of this part of the experiment are shown in the right-hand column of the same table shown below.

V.A. Through Microscope (Objective Blur)	*Thru these Lenses*	*V.A. on Actual Chart (Subjective Blur)*
LPED (50)	Plano	DEFPOTEC (20)
LPED (50)	+1 D.	TOZ (70)
TOZ (70)	+2 D.	E (200)
FP (100)	+3 D.	Blur out
E (200)	+4 D.	
E (200)	+5 D.	
Blur out	+6 D.	

The data shown in this table substantiate the first part of the experiment in which it was concluded that the correlation between the *degree* of blur of the subjective image and the *degree* of blur of the physical or objective image is far from a one to one relationship.

Let us now examine the possible significance of this experiment in connection with our optometric examination and observations. One rather surprising conclusion follows. In our clinic during the war years, we trained quite a large number of myopes for better visual acuity in their desire to pass the acuity tests of certain branches of the service. It is recalled how, at that time, we would explain to these patients how the eye was a very imperfect optical system and that although the nature of the retinal stimulus was a badly blurred and aberrated reproduction of the object viewed, even in the emmetropic eye, it was quite possible, through training, to improve acuity to a surprising degree in some cases in spite of this fact. I am convinced now, that in the myope or astigmat the retinal image, instead of being poorer than such a person's subjective vision, is actually *better*. This to me, allows a more logical understanding of why it is that we *can* improve such a myope's vision by training. In other words, the retinal image, in view of the experiment, is no longer a detriment since if the myope could perceive with the same degree of clarity as exhibited by his retinal image, he would automatically have increased visual acuity. It is not the purpose of this experiment to attempt an explanation of why the myope does not have this increased visual acuity. It has, however, been proposed by some that the human being is an extremely critical mechanism for judging any

change which may take place in the optical characteristics of his retinal image. The explanation offered for this has been that any minute change in blur circle size, which fact actually governs the quality of an image, will be readily appreciated by the fact that the fovea is extremely small.

Consider also an astigmat who in one case will be extremely critical in the judgment of the relative darkness of the lines on the astigmatic dial, and who reports pronounced increase in visual acuity with the addition of a simple —.25 cylinder. On the other hand, we are all well-aware of astigmats who measure a relatively high degree of astigmia and to whom the presence or absence of a cylindrical correction is of no consequence. If astigmia and its correction are to be explained on the original physical concept which was discussed at the beginning of this paper, and which stated that the projected image of the astigmatic dial is simply an exact duplicate of the retinal image, it would be impossible to explain such differences among astigmats. Consider again the photograph of the astigmatic dial and the statements made to the effect that but slight changes in the relative clarity of the lines in the sheep's retinal image were produced, even though cylinders of no small amount were added. This fact permits us to reconcile how certain individuals with a pronounced degree of astigmia are subjectively unaware of such a condition.

We are all acquainted with the expected results of removing the crystalline lens to render the eye aphakic, and with the accompanying drop of visual acuity to a very low level. If we realize that the actual change in the retinal image is not nearly as great as the expected subjective drop in acuity would indicate, we are better able to understand such cases on record which have shown a surprising degree of acuity at both far and near in the uncorrected aphakic state.

ABSTRACTS

INHIBITIONAL PALSIES. J. I. Pascal. Optometric World. 36 (5), 28-30, May 1948.

Cases of paralytic vertical imbalance present difficulties sometimes in differentiating between a paresis of an inferior muscle in the hypertropic eye and its contralateral antagonist in the other eye.

A right hypertropia due to paresis of the right inferior rectus may simulate a right hypertropia due to paresis of the left inferior oblique. In both cases the hypertropia is most marked in the right side of the field. Also a lag of the paretic muscle in its field of action will be matched by a lag of the contralateral non-paretic antagonist in its field of action when the paretic eye fixes. This lag is explained by the lessened innervation sent to the contralateral antagonist because of a lessened innervation sent to its yoke muscle, the antagonist of the paretic muscle.

The mechanism of the diagnostic sign serving to differentiate between the two muscles, namely that of applied head tilt is explained.

R. E. B.

ORTHOPTICS SPECIFICATION BY A GRAPHICAL METHOD*

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The graphical method of analysis of the relationship between accommodation and convergence appears to have been introduced by Donders[1] in 1864. Since then the technique has been employed continuously by textbook writers and investigators as a means of presenting the fundamental relationships between accommodation and convergence. In recent years the technique has been adapted for use as a routine method of analysis of the accommodation-convergence relationship in clinical cases. The essential features of this system as a means of analyzing routine clinical data were described in 1943 by Fry[2]. More recently the author[3] has described in considerable detail a number of characteristics of the accommodation convergence relationship in a variety of clinical cases, using the graphical method of analysis and presentation.

The graphical technique has a very useful application in the specification of the type of orthoptic training to be given. Instead of verbalizing the specifications, the desired effects of the training can be indicated by means of an arrow, or some comparable symbol, on the graph itself. In Figure 1 are shown in composite form the arrow indications equivalent to the following familiar verbalizations:

A. Binocular minus lens training
   (a) at 33 cm.
   (a′) at 40 cm.
   (a″) at infinity

B. Binocular plus lens training
   (b) at 33 cm.
   (b′) at 40 cm.
   (b″) at infinity

C. Base-out prism training
   (c) at 33 cm.

*Read before the annual meeting of the American Academy of Optometry, Winston-Salem, North Carolina, December 7, 1948. For publication in the October, 1949, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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(c′) at 40 cm.
(c″) at infinity

D. Base-in prism training
(d) at 33 cm.
(d′) at 40 cm.
(d″) at infinity

E. Monocular accommodative amplitude training
(e) at a maximum accommodation level, i. e. at the near point of accommodation

F. Monocular accommodative relaxation training
(f) at the minimum accommodation level, i. e. at the far point of accommodation

G. Monocular accommodative response training, also known as accommodative "rock"
(g) at a submaximal level of accommodation

H. Binocular "push-up" and "recession" training
(h) proximal to the eyes, e. g. near point of convergence push-ups, or binocular near point of accommodation push-ups
(h′) distal to the eyes, e. g. maintenance of fusion of receding targets (as in esotropia training), or binocular resolution of receding acuity test objects

I. "Jump" duction training
(i) at 40 cm.

The arrows on the graph can provide additional detail in the specification of orthoptic training in that they may be regarded as having certain inherent attributes, (1) *direction*, (2) *position*, and (3) *length*. With regard to the first of these three, *direction*, the following conventional training techniques are represented:

1. Arrow pointing straight up: binocular minus lens.
2. Arrow pointing straight down: binocular plus lens.
3. Arrow pointing horizontally to the right: base-out prism.
4. Arrow pointing horizontally to the left: base-in prism.
5. Arrow pointing obliquely upward along demand line: binocular push-up or "near point" exercises.
6. Arrow pointing obliquely downward along demand line: binocular recession or "far-point" exercises.
7. Arrow pointing obliquely upward along phoria line: monocular accommodation stimulation, either by minus lenses or by push-up. (The occlusion of one eye permits the eyes to assume the phoria position.)

8. Arrow pointing obliquely downward along phoria line: monocular accommodation relaxation, either by plus lenses or by recession of the target.

The only ambiguity of specification would be in the last two items, numbers 7 and 8, as stated.

With regard to the second of the above three attributes, *position*, the following information is provided. First, the position of the arrow with respect to the plotted clinical data indicates whether it is the blur, break, or recovery that is to be dealt with. Thus, in Figure 2 it is

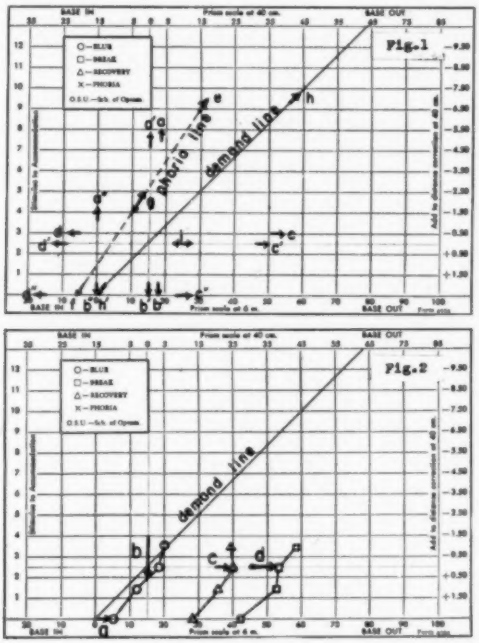

Fig. 1. (Top) Graphical representation of several conventional categories of orthoptic training as listed in the context. The letters correspond to those given in the list. The phoria line corresponds to a case having a distance phoria of 6Δ exo and an A.C.A. ratio of 4Δ per diopter of accommodation. The demand line represents the simultaneous demands on accommodation and convergence for clear single binocular fixation at various distances with the refractive errors corrected, and is also known as the "orthophoria" line and as "Donders" line.

Fig. 2. (Bottom) The circles represent blur points defining the limits of positive fusional convergence, plotted in the manner described by Fry.[2] The triangles represent base-out recovery points, and the squares represent base-out-to-break points. The interpretation of the arrows is given in the context.

apparent that the arrow labeled *a* calls for base-out prism training to increase the range of positive fusional convergence, or operationally speaking, to increase the base-out-to-blur range. It is also apparent that arrow *b* calls for binocular minus-lens-to-blur training to increase the range of positive fusional convergence. Similarly, arrow *c* indicates prism training to increase the recovery range on the base-out-side and arrow *d* indicates prism training to increase the break on the base-out side.

In the case of binocular push-up and recession techniques the interpretation of the position of the arrow is of particular importance in the analysis of the effect of the training. This type of procedure may represent positive fusional convergence training, negative fusional convergence training, or simple accommodative training, depending on how the demand line courses through the zone of clear single binocular vision. The relationships of push-up and recession tests or techniques to the limits of the zone of clear binocular vision have been analyzed in a previous paper.[4]

Secondly, the position of the arrow indicates the basic stimulus values of accommodation and convergence to be used as reference points in the orthoptic procedure. This in turn defines the amount of lens and prism and the fixation distance to be used, or, in the case of most of the commercial types of orthoptic instruments, the convergence and accommodation scale readings to be employed. Thus in Figure 2 the following convergence and accommodation specifications are indicated:

Figure Legend	Convergence	Accommodation
a	5△	0
b	15△	2.00 D.
c	40△	2.50 D.
d	54△	2.50 D.

The same specifications may further be expressed in terms of the distance of the fixation object and the auxiliary spheres or prisms to be used. Thus, the *a* specification in Figure 2 can be met by the binocular fixation of a distant target and the placement of a total of 5△ base-out in the spectacle plane. It can also be met by the fixation of a 40 cm. target through +2.50 D. spheres combined with 10△ base-in. In any of the Brewster type orthoptic instruments or in any of the mirror haploscope or amblyoscopé types of instruments the setting of 5△ of convergence and zero accommodation can be made directly on the scales and dials usually provided with such instruments. The graphical technique facilitates specifications applicable to all varieties of instru-

mentation. By the same token it facilitates the transfer of procedure from one type of instrument to another with considerable simplicity.

The third attribute of the arrow, its *length*, can be used arbitrarily to represent supplementary quantitative values. Thus in Figure 1, the length of arrow *g* may be considered to represent the "rocking" of accommodation through a range of 1 diopter, or more specifically, between the 4 and 5 diopter stimulus levels. In the same figure the length of arrow *i* may be considered to represent a "jump" duction exercise in which the "jump" represents an alternation of stimulus values between 22△ and 27△ of convergence. In Figure 2 the arrow *b* is 2 diopters in length and so may be considered to represent the specification that the orthoptic training should be continued until an additional 2 diopters of plus lens is acceptable in the direction indicated. Corresponding to the same general system of specification arrow *d* in Figure 2 would call for an increase in the base-out-to-break range of 8△.

The three attributes listed are in fact only the simplest attributes, and so their symbolic representations are virtually self-evident. It is, of course, obvious that further characteristics can be incorporated in the design of the arrow, i.e., in its shape, color, etc., to represent certain other specifications in the training procedure. Such representations would have no fundamental relationship to the graph itself and would therefore have to be chosen arbitrarily.

In certain types of orthoptic or visual training the functions of accommodation and convergence are presumed to have no critical bearing on the visual functions being subjected to training.[5] Nevertheless, it is often a matter of expediency that the accommodation and convergence stimulus conditions be specified, even in these instances, to rule out spurious effects that may be produced if the stimulus conditions are not controlled. Hence, the graphical technique of specification may be said to be useful not only in cases in which the functions of accommodation and convergence are directly involved, but also in cases in which the accommodation and convergence stimulus conditions must be specified. In any event, if the basis for prescribing visual training is to any degree dependent upon clinical findings related to accommodation or convergence the graphical technique has a fundamental application.

SUMMARY

The accommodation and convergence stimulus conditions to be met in orthoptic training may be simply and easily specified in the graphical system described. The use of arrows as symbols facilitates a direct representation of the desired type and degree of each of a variety of conventional training techniques. The interpretations of the arrows

are made in terms of their length, direction, and position on the accommodation-convergence graph ordinarily used for case analysis. The use of arrows eliminates detailed verbalization of instructions and procedure specification, and is equally applicable to most orthoptic instruments.

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ABSTRACTS

CLASSIFICATION OF NONPARALYTIC STRABISMUS. S. V. Abraham. American Journal of Ophthalmology. 32.1.93-98. 1949.

The present concept of nonparalytic strabismus as a condition in which one or another of the exciting factors influences the state of activity of the convergence function is not new completely. This article, however, gives a somewhat new approach to the view that the activity (plus or minus) of this function determines changes from the anatomic position of rest of the eyes.

This concept is tied closely with the evolution of the convergence function as well as that of the position of the eyes. The fusion faculty is considered to be normally, rather than abnormally, weak in the formative years because then it is in the process of development in the individual and it is relatively new in the evolutionary life of the species.

A simple classification of nonparalytic strabismus attempts to correlate the basic physiologic principles involved in the types of strabismus found. The author's data are derived from 1,054 cases of nonparalytic strabismus. He concludes that the primary exciting factors in the production of nonparalytic strabismus are: (1) The general physical and mental health. (2) Inequality in the visual efficiency of the two eyes. (3) Mechanical conditions (position of the eyes in the head, abnormal muscle lengths, etc.)

Secondary predisposing factors are: (1) The condition of the convergence function. (2) The errors of refraction. (3) The accommodation.

Other factors requiring attention and treatment are such sequelae as: (1) Amblyopia of the active suppression type. (2) Structural muscle changes. (3) Disturbed function of the fusion faculty.

R. E. B.

HOW MANY STUDENTS NEED PROFESSIONAL EYE CARE? Joseph Tiffin. The Educational Focus. Rochester, N. Y. (Published by Bausch & Lomb Optical Company) 20.2.27-30. 1949.

The ortho-rater is described and its place in visual survey work is outlined. The author reports a survey of 506 high school students wherein 48 per cent failed composite near-job visual requirements, and 54 per cent failed composite near-and-far-job visual requirements.

C. C. K.

THE USE OF TELESCOPIC SPECTACLES TO IMPROVE VISUAL ACUITY FOLLOWING IRIDECTOMY— A CASE REPORT*

George C. Wise†
Hartsville, South Carolina

CASE HISTORY

This patient developed congenital cataracts shortly after birth. Ocular surgery was performed when the patient was 11. He had the history of the usual childhood diseases, including measles and mumps. The patient was unable to present much in the way of family history. He had learned to read and write since the operation. His occupation was a street singer with guitar and tin cup. Present age of patient, 22.

The patient was wearing the following correction:

O.D. + 10.50 D. sph. ⌒ —2.50 D. cyl. axis 175.
O.S. + 10.50 D. sph. ⌒ —2.50 D. cyl. axis 15.
Add O.U. + 3.00 D. sph. in bifocal form.
Visual acuity, with or without glasses, O.D. 20/800 by guessing, O.S. 20/800.

PRELIMINARY FINDINGS

The patient was an exotrope with the right eye turning out. He also had nystagmus. The lids, sclera and conjunctiva were healthy and were of normal color. There was no pathology present. The patient's eyes would turn to extreme orbital limits but these movements were jerky. The nystagmus was less in evidence at extreme lateral limits of versions. The patient's reaction to light was very slight.

OPHTHALMOSCOPIC FINDINGS

Cornea clear. Iris very irregular in shape. Irregular portions of capsule remain in eyes. It was impossible to secure a good view of either retina.

REFRACTION

Obviously, the only refraction which could be effectively done was a subjective test. The findings from this were:

O.D. + 9.50 D. sph. ⌒ —2.50 D. cyl. axis 175.
O.S. + 9.50 D. sph. ⌒ —2.50 D. cyl. axis 15.
Add. O.U. + 3.00 D. sph.

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*Submitted as a portion of the entrance requirements of the American Academy of Optometry. Approved by the Examining Board. For publication in the October, 1949, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist. Fellow, American Academy of Optometry.

Visual acuity with the above, O.D. 20/800 by guessing, O.S. 20/800.

As the subjective findings did not improve vision, the Kollmorgen telescopic unit was next used over the patient's left eye. The 2.2x unit gave the patient 20/160 visual acuity for distance and the + 12.00 D. sph. reading addition allowed him to read 0.75 M type.

This telescopic unit was prescribed, and for the first time in the life of this patient, he was able to go about the streets without someone assisting him.

Six months later he returned to see whether or not contact lenses would further improve his vision. The Feinbloom fitting set was used, and the following formula seemed to best serve the patient's needs:

O.D. 4326 (0.62) 18.00 8 mm.
O.S. 4326 (0.62) 14.00 10 mm.

This contact lens correction gave the patient the following visual acuity: O.D. 20/200. O.S. 20/160. The patient was able to wear contact lenses for 3½ hours before the onset of the haze. After 3½ hours wear, there was a slight congestion of the left eye. With the contact lenses in place the nystagmus seemed to reduce in amount.

The patient did not have the contact lenses made, and is still wearing the telescopic spectacles.

1311 HOME AVENUE
HARTSVILLE, SOUTH CAROLINA

ERRATA

In the article entitled "Accommodation and Convergence with Contact Lenses," which appeared in the September issue, the following corrections should be made:

1. Equation (5) should read

$$\Delta F = \frac{\frac{1}{v+d} + F}{1 - d\ (\frac{1}{v+d} + F)} - \frac{F}{1 - dF}$$

2. Equation (8) should read

$$C_t = \frac{P}{v+S} - R\Delta F - C_p - C_t + 2FX$$

3. The first sentence beneath Figure 4 on page 383 should read "Figure 3 and Figure 4 represent series of similar curves to that of Figure 2 . . . "

MATHEW ALPERN.

ANISOMETROPIA—CASE REPORT DEMONSTRATING EFFECTS OF IMPROPER CORRECTION*

Monroe J. Hirsch†
Los Angeles College of Optometry
Los Angeles, California

While cases of anisometropia are by no means rare, the case to be described is of interest because for six years the patient wore an optical correction which precluded the possibility of normal binocular vision.

Mr. D. H., aged 21, a student at Stanford University, appeared at the office of the author to have an eye examination. He reported no symptoms of discomfort, and stated that he merely wished to determine whether the correction lenses he was wearing were adequate. The lenses which had been prescribed six years prior were:

O.D. —2.50 D. sph.
O.S. —1.50 D. sph.

Visual acuity was 20/20 with each eye and with both eyes through the lenses. With no lenses it was 20/200 for the right eye, and 20/20 for the left eye and for both eyes. The uncorrected visual acuity for the left eye being unduly high for the degree of myopia indicated by the lenses was immediately suggestive of correction by too much minus lens. Retinoscopy revealed the following:

O.D. —2.50 D. sph.
O.S. +3.00 D. sph.

At this point, the author again asked the patient about the correction lenses, date of prescription, and degree of comfort with which they had been worn. The patient became aware that the examiner was somewhat surprised, and said, "If you are worried about the left eye, I know that it is far-sighted, and I am wearing a near-sighted lens on it. The lens was prescribed this way to strengthen the weak eye."

In cases of this sort, certain difficulties are encountered in performing the subjective examination. It is usually very difficult to relax the accommodation of the hyperopic eye while testing it by itself. On the other hand, when its fellow eye is simultaneously fixating the distant target, accommodation can be relaxed. This, of course, suggests that a method of examination, similar to the Turville technique

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recently described by Morgan,[1, 2] would be the method of choice. However, it is not the only method which can be used. In the present case, the Turville set-up was not available, and in its stead, the following procedure was employed:

The subjective correction for the right eye alone was determined. This was —2.50 D. sph. The maximum amount of plus lens which could be placed before the left eye when tested alone was +1.00 D. sph. The above lenses were placed before the respective eyes, and in addition, 4 Δ base-up before one eye and 4 Δ base-down before the other. The patient looked at the Snellen 20/20 line at 20 feet seeing two images, one above the other. He was asked to fixate the image corresponding to his fully corrected right eye, and rapidly shift to the other. It was found by this procedure that the second image, seen by the left eye, was momentarily blurred. Plus lens was now added until the second image was clear simultaneously with the other. The lens necessary to accomplish this was +2.50 D. sph.

The principle involved here is simple, and yet is one sometimes overlooked. Since there is conjugate accommodation in the two eyes, unless both are required to accommodate similar amounts, clear vision in each eye becomes impossible. It is interesting that the pattern of accommodation for the more hyperopic eye differs when this eye is used monocularly and when it is used along with the other eye. Thus monocularly, any plus lens in excess of +1.00 blurred the vision of the left eye. Yet, when the vision was tested, with the right eye fixating the target, +2.50 D. sph. gave 20/20 vision. The author previously has observed this same phenomenon on hyperopic anisometropes. It indicates a limitation in the monocular subjective examination, and seems to argue very strongly for the administration of the subjective test at all times under conditions similar to the Turville technique. Many cases of asthenopia, and neuromuscular incoordination may be attributable to the need for more plus lens in one of the eyes, which fact is obscured when the subjective test is administered monocularly.

It should be pointed out that with the old prescription, this patient had 20/20 vision in each eye. However, in alternating an occluder from eye to eye it took some time for the vision to clear, the time for the left eye to clear (4.00 D. of accommodation being brought into play) being longer than for the right eye to clear (relaxation of the same amount of accommodation). With the new correction lenses in place (—2.50 D. sph. on the right and +2.50 D. sph. on the left) vision was clear at all times on the right eye, and was clear on the

left eye when the occluder was first moved from left to right eye, but after a few moments became blurred.

The remainder of the examination revealed orthophoria, ductions within normal limits, and in short no abnormal findings. This in itself is quite remarkable. It should be clear that for the preceding six years, while wearing these lenses, the patient could not have had satisfactory binocular vision. Tests taken through the old glasses indicated that his comfort with them was consequent upon a complete suppression of vision of the left eye. In order for the left to have been the fixating eye, 4.00 D. of accommodation would have been necessary, and this clearly was not the course that would be chosen. At times in the past, the patient had gone without his lenses for a day or two at a time, and noticed that things looked strange for a short time but soon cleared, and all was well. Reading was difficult under such conditions but was possible. It is probable that in going without his lenses, he accommodated 2.50 D. and fixated with his left eye. This probably necessitated suppressing the right eye, a fact which may account for the time lapse of a few minutes to become accustomed to these conditions. In reading without the lenses, accommodation was probably relaxed, the right eye was used, and the left suppressed.

The question of what lenses to prescribe was more difficult than the realization of what was the status of the visual apparatus. That normal binocular vision could be elicited seemed probable. The patient mentioned that he had not been able to perceive depth in stereoscopic pictures in the past. With the new correction lenses in place he was presented with a stereoscope and stereogram having a tri-dimensional scene. Fusion was present, and the patient commented that for the first time he was able to see such a view tri-dimensionally.

The major difficulties were (a) The possibility of aniseikonia associated with the anisometropia, and (b) diplopia due to vertical prism differences if the proper correction lenses were given. The former possibility, that of aniseikonia, was ruled out by using the Howard-Dolman apparatus. As was pointed out previously by the present author[3, 4] the Howard-Dolman test so administered as to yield a position of subjective equality (PSE) may be used as a screening test for the presence and degree of overall or horizontal size difference. This patient, wearing the newly determined correction exhibited a PSE very close to zero, and on this basis the assumption was made that the anisometropia was probably due to axial length differences in the two eyes instead of refractive power differences[5, 6] and hence the condition was not complicated by the presence of aniseikonia.

The prismatic differences created when the patient looked through peripheral portions of the lens might have been partially corrected for by the use of slab-off prisms. The new correction was placed in the trial frame, and the subject was asked to look through various peripheral portions of the lens. Diplopia occurred upon looking up, down, right or left but only in looking through the most extreme sections of the lenses. Since the patient already wore the proper lens on the right eye, it was deemed to be the simplest and most economical procedure to merely change the left lens, using a single-vision lens of +2.50 D. sph. The patient was warned that diplopia might result, especially in looking down through the lenses, and if this proved to be the case, slab-off prisms would be indicated.

At present, the patient has been wearing the new correction for three months, and no further attention seems to be necessary. Diplopia in the periphery was present the first day, but since then has been absent. The patient notices a definite difference in the appearance of objects, pointing out that tree trunks, for example, now appear to have depth. There is complete comfort, and the report of appreciation of depth seems to indicate the presence of normal stereoscopic binocular vision. The patient attempts to move his head instead of his eyes, hence using the middle portion of the lenses as much as possible and avoiding any diplopia or symptoms of distress.

Summary: A case with 5.00 D. of anisometropia is reported. The patient had been wearing lenses which precluded the possibility of fusion or normal binocular vision. Despite 20/20 vision for each eye tested monocularly through the old prescription, when the eyes were used simultaneously one eye had a considerably lower visual acuity. It is of special interest that despite the wearing of such a prescription for six years, fusion could be elicited immediately, and a short time after wearing the proper correction, normal binocular vision was obtained. The only correction found necessary was a pair of single vision lenses, accurately correcting the ametropia.

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THE HERITAGE OF OPTOMETRY*

In a sense, the writer is a second generation optometrist. It seems today that I cannot remember the time when I was not aware of eye examinations, frames and lenses. Even as a boy when refractive ametropias meant nothing to me I listened to the adults around me as they discussed myopia and presbyopia. As I now recall it, some of the talk of that day revolved around competitive prices on materials, as in 1910 the refraction fee as a separate entity was just coming over the horizon.

I can well remember the examining room of that day. In a sense, ours was a two-seater, a long gloomy hall-like room, with a chair and a trial case for a patient at each end. When two patients were present at the same time, they sat at a 20-foot distance facing each other, view-

*Excerpts from the commencement address given by Dr. Carel C. Koch, at the first graduation exercises of the Chicago College of Optometry, Chicago, Illinois, on September 20, 1949.

ing test charts that were placed over each other's heads. These charts were dimly illuminated by gas mantles and gas was the light source used for the retinoscopy and the simple muscle testing of that day.

The refraction itself rarely took longer than 10 to 15 minutes and I suspect that's about all anyone could stand of that spooky refracting room with no ventilation and "superheated" summer and winter by the numerous gas jets which burned all day long. The optometrists of that period certainly had much to be thankful for when electricity came along and the heat-producing gas could be relegated to the kitchen.

Certainly that picture seems strange today, and one is apt to dismiss those early optometric efforts as being of little consequence. Yet, those men did much to establish optometric recognition for the heritage they knew was theirs. The group of optometrists who practiced between 1880 and 1920 put the finishing touches to the groundwork of present-day optometric practice. They bridged the gap between the opticianry which was our heritage, and the professional practice of this period.

Unlike many professions, the ancestry of present-day optometrists can be traced in a direct line back through the past four centuries. During this entire time, the making of spectacles and scientific instruments, and the caring for the visual needs of the people was an honorable calling conducted along the up-to-date accepted trade, business and professional standards of the day.

Long before these United States were settled to any great degree, the historical ancestor of the present-day optometrist was a person of consequence in his home community in Italy, France, Holland, Germany and England. According to Sir William Champness,[1] spectacle makers had organized themselves into guilds by the latter part of the sixteenth century in both France and Germany, and the English spectacle makers followed suit when they were granted a charter of incorporation for their guild, the Worshipful Company of Spectacle Makers, in 1629.

Of course, the very fact that these men and their heirs organized these groups into official guilds both on the continent and in England, indicated their strength and solidarity, and it, of course, also indicated that even in those days there was need for regulations to keep those in line who would transgress from the standards of the day. Then, as now, there was need for organization, to keep before all men engaged

[1] Sir William Champness, Past Master and formerly Clerk of the Company. The Worshipful Company of Spectacle Makers—A Brief Historical Note. Hereford Times, Ltd., London.

in the work the ideals which must accompany a technical calling.

According to Champness, the minutes of the court show that "for about 200 years after the charter was granted the master and wardens exercised great activity in enforcing their powers under the Charter, Bye-Laws, and Ordinances." Now these many years later the Worshipful Company of Spectacle Makers is one of the important optometric examining and certifying bodies in England.

In this manner the high traditions surrounding the field of optics were kept intact and the men who came to our shores to make and fit our early spectacles brought with them the skills so ably taught abroad. They also came prepared to uphold the fine traditions of the past as these pertain to optics, instrument making and the manufacture and fitting of spectacles.

These early American craftsmen first set up their shops in Boston, New York and Philadelphia, and the latter city became the center of skilled lens makers early in the nineteenth century. It was here that the first cylindrical lenses were ground around 1840. It is interesting to note that astigmatism, while known, was not corrected until about 100 years ago, and the credit for making this correction possible goes to the oculists and opticians of that day.

Between the sixteenth and nineteenth centuries the use of spectacles for the correction of certain common visual problems became very widespread in both Europe and the Americas. During this period these ancestors of present day optometry who supplied this visual care gradually broadened the scope of their knowledge. From an early beginning based upon the science of physics and astronomy they gradually added anatomy and physiology. These basic sciences gave them a foundation which added materially to their standing in the scientific worlds of their day and helped these optometric ancestors of ours avoid the long periods of quackery through which so many professions floundered only to emerge at a later date with much to live down.

We in optometry have a four hundred year heritage that is free from quackery. Few of the other healing arts of today can claim as much.

Ocular refractions on a large scale as we know them first developed after our Civil war, and many refinements of optometric techniques can be traced to such celebrated early optometrists as Lockwood, Drakeford, Cross, Eberhardt, M. B. Ketchum, Todd, Maybee, Bestor, Dillworth, DeMars, McFadden, Seward and Palmer—to mention but a few. These men laid the groundwork for modern optometry by helping apply modern true scientific principles to refraction room procedures.

Well grounded as they were in the basic sciences, they built for optometry acceptable and authentic techniques which meet professional requirements and stand the test of time.

As American optometrists, we are grateful to them and the men with whom they worked for their painstaking guidance which resulted in our having the great confidence of the American public. This is part of the fine heritage of optometry. And, too, we find, thoroughly woven into the heritage of optometry, the early trend away from the commercial pattern of practice. This was first evidenced by the technical and scientific character of the early optical shop. It was really a precision laboratory for that day, and the normal evolutionary tendencies gradually brought into being the optometric office now recognized for its high standard of eye care.

That optometry has an honorable place in the scientific world of today is entirely due to the fact that basically our refractive procedures follow the pattern set in the scientific fields of physics, anatomy, physiology, psychology and biophysics. As long as optometry keeps its roots deep in the fields of the basic sciences is has nothing to fear, but if it should abandon these fundamental truths and wander off into the never-never land of cultism that serious criticism from well trained professional persons will inevitably occur.

CAREL C. KOCH

Obituary

RUDOLPH LUNEBURG

On August 19, 1949, Dr. Rudolph Luneburg suddenly passed away in Great Falls, Montana. He was a newcomer to the field of visual science or, as he would have preferred to say, an interested outsider. Yet his unusual mastery of applied mathematics, combined with his deep interest in visual perception, enabled him in a surprisingly short time to make one of the most outstanding contributions in the theory of binocular vision. It is indeed rare that a scientist so richly endowed with mathematical powers takes an active interest in the problems of vision. That is why we especially, who are working in this field, deplore his untimely death. His "Mathematical Analysis of Binocular Vision" which offers the first possibility of quantitatively exploring an individual's visual space represents a contribution of the highest rank. Yet had he lived, further achievements would surely have followed; for his plans called for still greater generalization of his theory.

Rudolph Luneburg was born in Germany in 1903. He received his mathematical training at the University of Goettingen where he became an assistant at the Mathematical Institute. When the Nazis rose to power in Germany, he accepted a research fellowship at the University of Leyden, the Netherlands. In 1934 he came to the United States and after serving as research associate in mathematical physics at New York University, he became chief mathematician in the Scientific Instrument Department of American Optical Company at Buffalo. In 1944, he was invited, under a government sponsored defense program, to give a summer lecture course on the mathematical theory of optics at Brown University. In 1946, he became a research mathematician on Navy sponsored projects assigned to the Institute for Mathematics and Mechanics of New York University. After serving a guest professorship at the University Marburg in Germany in 1948, he accepted an appointment at the University of Southern California early this year.

His interest in vision crystallized under the influence of Professor Adelbert A. Ames, Jr., whose fundamental work in visual perception stimulated him into analyzing the nature of binocular vision. The experimental investigation of his results is a current Navy project at Presbyterian Hospital, New York.

This work in binocular vision alone, not to mention many others in different fields, showed him a master of applied mathematics distinguished by a rare insight and grasp of fundamental problems; and with exceptional powers of analysis, invention, and concentration. The passing of Rudolph Luneberg is a great loss for visual science.

PAUL BOEDER

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

ACADEMY TO MEET AT CLEVELAND

Fellows who have never attended an annual meeting of the American Academy of Optometry may wonder about the apparent lack of promotional publicity about the convention. Those who attend regularly do not wonder for they know the features which make such a scientific gathering a success do not lend themselves to sensational blurbs. The tourist spots of the convention city help naturally, to

make the convention a success, as does the excellence of the headquarters for the meeting. But these are not the real drawing cards for an Academy gathering. Those who have attended are drawn by the unmatched excellence of the technical papers, the chance for renewal of valued friendships begun perhaps one, five or ten years ago at a similar gathering, and the meeting of new friends interested in the welfare of optometry; the thrill of discussing scientific progress in optometry with the men who are making the progress.

An Academy convention might sound dull to those who have never attended one—but the Fellows who attend year after year do not find it so. They find it brings anew the feeling that optometry is a vital, progressive profession moving ahead year by year.

Plans for the 1949 Academy meeting are complete except for last minute details, and now it's up to each individual Academy member to be on hand in Cleveland in December to make the convention a complete success. A preview of the four-day session has already appeared in this Journal—technical papers, special lectures and seminars on aniseikonia, contact lenses, orthoptics and pathology; a General Electric-sponspred lighting demonstration, special papers, and banquet. A glance at the following list of speakers who will present the papers is assurance that the program will be as stimulating and varied as always:

Glenn Fry, Mathew Alpern, Henry Knoll, George Knoll and Vincent Ellerbrock from The Ohio State University, School of Optometry; Howard Bartley, Michigan State College; Paul Boeder, American Optical Company, Southbridge, Massachusetts; Rudolph Ehrenberg, Granite Falls, Minnesota; Richard Feinberg, Pacific University, School of Optometry; Irving P. Filderman, Southern College of Optometry.

Eugene Freeman and Z. V. Schoen, Chicago College of Optometry; Henry Hofstetter, Los Angeles College of Optometry; Fred Jobe, Bausch and Lomb Optical Company, Rochester, New York; Sylvester Guth, General Electric Company, Cleveland, Ohio; James H. Grout, Northern Illinois College of Optometry; E. J. Gording, Windber, Pennsylvania.

William G. Walton, Frederick Sinn, Onofrey Rybachok and Donald Kratz from Pennsylvania State College of Optometry; Ralph Wick, Rapid City, South Dakota; E. Craig Wilson, Rutland, Vermont; W. O. Vivian, Media, Pennsylvania; Irving I. Vics, Albany, New York; William Smith, Massachusetts College of Optometry; Roy Marks, Lansing Associates, New York City; Alfred Lit, Columbia University School of Optometry; Meredith Morgan, Jr., University of California, School of Optometry; Kenneth N. Ogle and Charles Sheard from Mayo Foundation, Rochester, Minnesota, and Edward Bind, Toronto, Ontario.

This is your convention—planned especially for you—so arrange to be in Cleveland December 10-13 to take advantage of it. The Program and Papers committee, as well as all the committees that have worked on convention arrangements, sincerely hope that every Academy Fellow will make a serious effort to attend the meeting and demonstrate his interest in learning about the important scientific advances in optometry in allied fields.

Make your reservation now at the Hotel Hollenden, 610 East

Superior Avenue, Cleveland, Ohio, and give your ticket agent a ring soon for a transportation reservation.

CHAPTER ORGANIZATION IN NORTHWEST PACIFIC AREA

Fellows of the Northwest-Pacific area got together during the summer to form a new chapter of the Academy. At the first meeting, Dr. Charles Simmons, Lewiston, Idaho, was chosen president of the new group, Dr. Hubert Thomas, Wenatchee, Washington, vice president, and Dr. J. Wolff, Spokane, Washington, secretary-treasurer. The initial gathering was in Spokane. A membership charter will be presented to the Northwest-Pacific chapter at the Cleveland meeting of the Academy.

NEW MEMBERS OF THE ACADEMY

The following optometrists and educators received their final approval for membership during the third quarter of 1949. The Academy welcomes these new members.

Dr. Harold M. Haynes. School of Optometry, Pacific University, Forest Grove, Oregon.

Dr. Ester M. Ingram. Winter Haven, Florida.

Dr. Jerome S. Lasky. 420 Broadway, Long Branch, New Jersey.

Dr. C. B. Margach. School of Optometry, Pacific University, Forest Grove, Oregon.

Mr. R. A. Phillips. 94, Burnt Ash Road. Lee, S. E. 12, London, England.

Dr. Z. J. Schoen. Chicago College of Optometry, 1849 Larrabee Street, Chicago, Illinois.

Dr. George Spence Wonnacott. 217 Pinnacle Street, Belleville, Ontario, Canada.

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department: such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

ON CAMPUS

The *Chicago College of Optometry* was busy making history during September. On the twentieth of the month, the college graduated its first class, and in an unprecedented action, awarded Fellowships in the American Optometric Foundation to five of its honor students.

Graduation exercises were held in the People's Church of Chicago

where Dr. Reuben Seid, president of the college, conferred Doctor of Optometry degrees on 49 students who represented nearly every state in the union, Hawaii, Puerto Rico and Canada.

The five students graduating with the highest honors were awarded the Foundation fellowships: A 15-year membership for Dr. Joseph Sutton Shepherd of Williamsburg, Kentucky, class valedictorian; a 10-year membership for Dr. Joseph Orent of Chicago, who shared *Summa Cum Laude* with Dr. Shepherd; a seven-year membership for Dr. Victor Philip Amato of New York City *(Magna Cum Laude)* and five-year memberships for Dr. Harry A. Levine of Brooklyn and Dr. John Christakos of Winnipeg, Canada *(Cum Laude)*. Dean Eugene Freeman presented the awards on behalf of the college.

Dr. Carel C. Koch, Secretary, American Academy of Optometry, and Editor, AMERICAN JOURNAL OF OPTOMETRY, gave the commencement address.* The D.O.S. degree was awarded Dr. Koch, and Drs. Morton L. Abram, Everett G. Force, Henry J. Frank, Thaddeus Murroughs, Ernest S. Takahashi, Edward R. Tennant, and Hyman S. Wodis.

Groundbreaking ceremonies will soon be the next order of business for officials of the *School of Optometry, The Ohio State University*. Bids for construction of their new two-story, $300,000 home were called in the last of August. The optometry building is to be located on West 10th Avenue, Columbus, next to the east wing of the University Hospital.

Pennsylvania State College of Optometry has added two of its recent graduates to the staff—Dr. George H. Crozier has been named assistant chief of clinics, and Dr. Carl J. Billig will serve on the faculty.

Research on the corneal contact lens has been started recently at Pennsylvania. With the aid of a new type Poser slit lamp, and other new equipment investigators will study the problem of haze and fitting problems.

Dean Richard Feinberg, *School of Optometry, Pacific University*, spoke before two Colorado groups in September—the Denver Personnel Association, and the Colorado Optometric Association.

Temporarily, at least, *Columbia University's School of Optometry* will continue in its present quarters, 433 West 123rd Street, New York. First, atomic researchers needed space the school was occupying; now it appears the present quarters are needed for a public school construction program. Construction of a permanent building seems the only solution to their continuing housing problems.

*See editorial, page 452, for excerpts from the commencement address.

Dr. Monroe Hirsch has left the Vision Laboratory of Stanford University Medical School to join the faculty of the *Los Angeles College of Optometry*.

Alumni of *Massachusetts College of Optometry* gathered in Boston on October 6 for a one-day educational meeting. The program included lectures and a special luncheon.

Graduation exercises were also held in September at *Southern College of Optometry*, at which 90 candidates received Doctor of Optometry degrees. Dr. Walter L. Bell, Sr., Macon, Georgia, was the commencement speaker.

A new faculty member of Southern this fall is M. E. Broom (Ph.D.), who will serve as an administrative officer and aid in the development of new courses for the school in the fields of reading and lighting.

STRABISMUS GROUP SPONSORS RESEARCH

A new research project to develop standard techniques of testing, classifying and training in strabismus is now under way at the Chicago College of Optometry. The project is sponsored by the recently-organized Society for Strabismus Research and the Chicago College of Optomery.

Dr. Thaddeus R. Murroughs, Linton, Indiana, will carry on the research, headquartering in the new clinic of Chicago college. Dr. Murroughs is a graduate of the University of Chicago, Northern Illinois College of Optometry and has practiced several years in Linton. He has served as chairman of the committee on research and visual training of the A.O.A. for the past four years.

In addition to the use of its clinic, the Chicago College of Optometry has put office, library and clerical facilities at Dr. Murroughs' disposal. American Optical Company, Bausch & Lomb Optical Company, Keystone, Lange and Stereo, Inc., are assisting the project by loans of equipment.

LOS ANGELES CITY COLLEGE ADDS OPTICS COURSE

Added to the curriculum of Los Angeles City College this Fall is a new course in ophthalmic optics similar to that offered in the Rochester Junior College of Opticianry, Rochester, Minnesota. College officials report that 38 students enrolled for the first semester's work. Standards of the course meet the requirements of the American Board of Opticianry leading to certification as Associate or Master in Ophthalmic Optics, according to the 1949-1950 bulletin of the College.

BOOK REVIEW

SPECTRAL-TRANSMISSIVE PROPERTIES AND USE OF EYE-PROTECTIVE GLASSES, Circular 471, R. Stair, 34 pp. 1948. Distributed by the Supt. of Documents, U. S. Govt. Printing Office, Washington 25, D. C., $0.20.

In response to a continuing demand for information on colored glasses for protecting the eye from injurious amounts of ultraviolet and infrared radiation, the National Bureau of Standards compiled and published a circular C421 in 1938. The success of this report is attested by the fact that it was out of print and thus copies of it were no longer available by 1948. The present circular 471 was written to supersede circular C421.

This publication provides spectral-transmissive data on most of the widely distributed brands and types of glass employed in protecting the eyes from harmful ultraviolet, visible, or infrared radiant energy, which may be encountered in industry, in driving, or while at home or at play. For this purpose approximately 300 curves in 93 figures are used to graphically illustrate the transmissive properties at various wave lengths for the different glasses. Of special note are the transmission curves for the common types of clear plastics such as methyl methacrylate, cellulose acetate, ethyl cellulose and polystryene.

In the paper considerable attention also is given to the standardization of shade numbers for protective glasses used in industry, glasses for special welding operations and the elimination of glare in sunlight.

Of particular interest in the circular is the discussion on the use of colored glasses for driving at night. In the discussion numerous methods are considered for reducing the glare from approaching headlights. Among these are the use of polarizing headlight lenses used in conjunction with polarizing windshields, various yellow tinted glasses, a "photochemical' glass wherein a rectangular area of each lens to the left of straight forward vision is darkened by a photochemical treatment and a "dipped" glass, wherein, after grinding, the center of the lens is clear but surrounded with a graduated blending into a darker shade. The importance of this discussion in view of the survey by the National Safety Council deserves special emphasis. The Council found that the various authorities questioned were unanimous in the belief that the advantage of reducing glare from automobile headlights by wearing colored glasses is more than counterbalanced by the extra hazard arising from the decreased visibility of objects.

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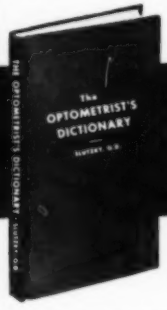

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